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Description

This invention relates to the automatic recognition of broadcast segments, particularly commercial advertisements broadcast by television stations.

Commercial advertisers are interested in log data showing when various commercials are broadcast on radio or television. This interest stems both from a desire to confirm that broadcast time paid for was actually provided and from an interest in monitoring competitors' advertising strategies.

It would be advantageous to be able to provide an automated method and system for logging commercial broadcast data which does not rely for recognition on the insertion of special codes in the broadcast signal or on cues occurring in the signal.

It is also desirable to provide such a method and system which can identify large numbers of commercials in an economic and efficient manner in real time, without resorting to expensive parallel processing or to the most powerful computers.

US Patent 3,919,479 describes a technique for identifying broadcast segments in which the segments are digitised and correlated with a digitised reference. When the output of the correlation function exceeds a predetermined threshold, a match is found.

The journal of the SMPTE, Volume 84, March 1975, pages 162 to 163, New York, U.S.A.; G Auerbach; entitled "A Pattern-Recognition System for Monitoring Video and Audio Signals" outlines a pattern-recognition type of system for recognising special broadcasts, wherein a "library" of commercial codes is produced by first obtaining video tapes of commercials having known and optimised quality. A data set is produced from these commercials by sampling eight frames at predetermined locations therein, and comparing the resulting signatures against broadcast signals.

French Patent 2,559,002 describes a technique for detecting the broadcasting of audiovisual information by a radio or television station. The document states that a received broadcast is recorded and a comparator compares the broadcast with recorded signatures contained in a memory. The signatures consist of at least a portion of the spectral analysis of the information to be detected, and the comparator comprises a plurality of processors each of which makes the comparison of the recording with at least one signature.

Summary of the Invention

It is an object of this invention to provide an automated method, apparatus and system for logging commercial broadcast data which does not rely for recognition on the insertion of special codes or on cues occurring in the signal.

It is another object of this invention to provide such a method, apparatus and system which can identify large numbers of commercials in an efficient and economic manner in real time, without resorting to expensive parallel processing or to the most powerful computers.

The present invention provides a method and apparatus for real-time continuous pattern recognition of broadcast segments by constructing a digital signature from a known specimen of a segment which is to be recognized. The signature is constructed by digitally parametizing the segment, selecting portions from among random frame locations throughout the segment in accordance with a set of predefined rules (i.e. different frames are selected for each segment, but the selection is always based on the same criteria) to form the signature, and associating with the signature the frame locations of the portions. The signature and associated frame locations are stored in a library of signatures. Each signature in the library is identified with a particular segment to be recognized. A broadcast signal is monitored and digitally parametized. For each frame of the parametized monitored signal, the library is searched for any signature that may be associated with that frame. Using the frame information stored with the signature, each of the potentially associated stored signatures is compared to the appropriate frames of the parametized signal. If a stored signature compares with the monitored data, a match is declared and the broadcast segment is identified using identification data associated with the signature.

In another embodiment of a method and apparatus according to the invention, a digital keyword derived from a designated frame in the parametized segment is identified as associated with the segment signature, but the association of that keyword with a particular segment signature is non-exclusive -- i.e., the same keyword can be associated with more than one signature. A plurality of additional frames is selected from among random frame locations throughout the segment in accordance with a set of predefined rules and, in a library of signatures, the keyword representing the designated frame and the words representing the additional frames are stored together with the offsets of the additional frames relative to the designated frame. A broadcast signal is monitored and digitally parametized. For each monitored digital word of the parametized monitored signal, the library is searched for any signature associated with a keyword corresponding to that monitored word, and the additional words of any such signature are compared with those words of the parametized monitored signal which are separated from the monitored word by the stored offset amounts. If the stored signature compares with the monitored data, a match is declared and the broadcast segment is identified using identification data associated with the signature data.

Brief Description of the Drawings

The above and other objects and advantages of the invention will be apparent upon consideration of the following detailed description, taken in conjunction with the accompanying drawings, in which like reference characters refer to like parts throughout, and in which:

FIG. 1 is a diagrammatic representation of the areas of a video frame sampled to derive parametized signal data;

FIG. 2 is a block diagram of a system according to the invention;

FIG. 3 is a block diagram of an experimental local site according to the invention;

FIG. 4 is a flowchart of a software program used in the system of FIG. 3;

FIG. 5 is a flowchart of a second software program used in the system of FIG. 3;

FIG. 6 is a flowchart of a third software program used in the system of FIG. 3;

FIG. 7 is a flowchart of a fourth software program used in the system of FIG. 3;

FIG. 8 is a block diagram of a local site according to the invention;

FIG. 9 is a block diagram of the signal processing subsystem of FIG. 8;

FIG. 10 is a block diagram of the correlator card of FIG. 9;

FIG. 11A is a block diagram of the audio capture card of FIG. 9;

FIG. 11B is a block diagram of the video capture card of FIG. 9; and

FIG. 12 is a block diagram of the central site and system communications of the invention.

Detailed Description of the Invention

I. Theory of Preferred Operation

The present invention can identify a segment of a broadcast signal by pure continuous pattern recognition on a real-time basis. No codes need be inserted into the broadcast signal prior to transmission and no "cues" or "signalling events" (e.g., fades-to-black or scene changes) that occur in the broadcast need be used in the recognition process. The broadcast signal can be either a radio broadcast, for which audio information is obviously used for the recognition process, or a television broadcast, for which audio information, video information, or both, can be used, and can be an over-the-air signal, a cable television signal, or a videotape signal.

Whether audio or video information is used, the broadcast signal is parametized to yield a digital data stream composed, preferably, of one 16-bit digital word for every 1/30 of a second of signal. (In the case of audio information associated with video information, the audio data is synchronized with the video frame rate to form an "audio frame".) The information is then processed in the same way whether it originated as audio or video.

A digital signature is constructed for each segment to be recognized. The construction of the signature is discussed in more detail below. However, it preferably comprises 128 bits representing eight 16-bit words corresponding to eight frames of signal information selected from among random frame locations throughout the segment in accordance with a set of predefined rules.

The incoming audio or video signal is digitized and parametized to yield, preferably, a 16-bit digital word for each frame of data. This also is discussed in more detail below. As the incoming signal is received, it is read into a buffer which holds, e.g., two minutes of signal data. Each word of this data is assumed to be the first word of an eight-word signature. Associated with each word of the signature is offset information indicating the spacing (i.e., the number of frames) between each such word and the first signature word. As each received word reaches a predetermined observation point in the buffer, the library of signatures of known segments to be recognized is searched for signatures beginning with that word. Using the offset information stored with the signatures, subsequent received words, already in the buffer, are compared to the remaining signature words to determine whether or not they match those remaining words of the signature.

In order for the method to operate in real time, all library comparisons must be made in the time that a received word remains at the observation point. because a television frame lasts 1/30 second, all comparisons for a given received word must take place within 1/30 second. If every segment signature in the library must be compared to the incoming frame signature data every 1/30 second, current computer speeds would allow comparison to only a few thousand library signatures. This would place an upper limit on the number of segments whose signatures can be stored in the library and the number of broadcast segments (e.g., commercials) which could be monitored without using expensive parallel processors or very powerful computers.

In the United States, however, as many as 500 different commercials may be playing within a market region at any given time. Assuming a market having 6 stations to be monitored, in the aggregate there may be as many as 4,000 or more occurrences of these commercials each day. Moreover, as many as 40,000 different commercial6 may be airing nationwide at any given time, and as many as 90,000 or more new commercials may be introduced nationwide each year. Accordingly, it is desirable that the system of the invention be capable of comparing, in real time, incoming frame signature data to many tens of thou-

sands of segment signatures representative of as many different commercials.

The number of signatures that can be stored and searched within the real-time limitation of 1/30 second and, hence, the number of broadcast segments which can be monitored can be increased to several hundred thousand using a designated frame keyword lookup data reduction method. using such a method, when a signature is constructed for a known segment, one frame from the segment is chosen, using criteria to be discussed below, as the key frame, its digital parametized equivalent becoming the keyword. The signature is still, preferably, eight 16-bit words, but the stored offset information now represents spacing from the keyword rather than from the first signature word. The keyword can be one of the signature data words, in which case the offset for that word is zero, or it can be a ninth word. The keyword also need not temporally precede all of the other signature words and often will not. If 16-bit words are used, there can be 2^{16}, or 65,536, possible keywords. Signatures are thus stored in a lookup table with 65,536 keys. Each received word that reaches the observation point in the buffer is assumed to be a keyword. Using the lookup table, a small number of possible signatures associated with that keyword are identified. As discussed below, one of the selection criteria for keywords is that on average four signatures have the same keyword. Typically, then, four signature comparisons would be the maximum that would have to be made within the 1/30 second time limit, assuming no data errors in the received signal. Four signatures multiplied by 65,536 keys yields 262,144 possible signatures for the system, meaning that the system has the capability of identifying in real time any of that number of broadcast segments.

Whether or not the designated frame keyword lookup technique is used, the present invention need not rely during the recognition process on any cues, signalling events or pre-established codes in the broadcast signal. It simply monitors the incoming signal and performs continuous pattern recognition.

Video information is parametized and digitized as described below. Although, in the description which follows, parametization is based upon signal luminance, it is to be understood that other or additional attributes of a video signal could be used for this purpose.

A number of areas, preferably 16 (although more or fewer areas may be used), of the video field or frame are selected. The size of each area is preferably eight-by-two pizels, although areas of other sizes could be used. The luminance of each area is averaged to produce an absolute gray scale value from, e.g., 0-255. This value is normalized to a bit value of 0 or 1 by cooparing the value to one of the following:

1. The average luminance of the entire field or frame;
2. The average luminance of some other area of the field or frame;
3. The average luminance of the same area in some previous field or frame; or
4. The average luminance of some other area of some previous field or frame.

The goal in selecting which comparison to make is to maximize entropy -- i.e., to minimize correlation between the areas. (Correlation refers to the degree to which the luminance value of one area is related to or follows that of another area.) For this reason, the fourth comparison, above, is preferred, with the previous frame being one to four frames behind the current frame. For the same reason, the distribution of the sixteen areas in the field or frame, as well as the sixteen areas in the previous field or frame, is preferably asymmetrical about the center of the field or frame, because it has been empirically determined that video frames are composed in such a way that there is too much correlation between symmetrically located areas.

A sample partial distribution of areas within a frame is shown in FIG. 1. Frame 10 is actually a video field of sampled pixels. (Hereinafter, "frame" will be used to mean either field or frame.) The luminance areas ℓ_n (n = 1-16) (not all sixteen shown) are the areas used for determining the parametized digital word for the current frame. The luminance areas ℓ_n' (n = 1-16) (not all sixteen shown) are areas whose values are held for use as the "previous frame" data for a later frame.

Whatever comparison is used, a bit value of 1 is returned if the luminance of the area in question exceeds the luminance of the comparison area. If the luminance of the area in question is less than or equal to the luminance of the comparison area, a bit value of 0 is returned. (It is to be understood that here, and in the discussion that follows, the assignments of ones and zeroes for data and mask values can be reversed.) By normalizing the data in this way, offset and gain differences between signals transmitted by different stations or at different times (caused, e.g., by different transmitter control settings), are minimized. The sixteen values thus derived create a parametized "frame signature".

A 16-bit mask word is created along with each 16-bit frame signature. The mask word represents the reliability of the frame signature. For each bit in the frame signature, if the absolute value of the luminance difference used to calculate that bit value is less than a threshold or "guard band" value, the luminance value is assumed to have been susceptible to error (because of noise in transmission), and so the mask bit for that bit is set to 0, indicating suspect data. If the absolute value of the luminance difference is greater than or equal to the guard band value, the luminance value is assumed to be such greater than the

noise level and the corresponding mask bit is set to 1, indicating reliable data. As discussed below, the number of ones or zeroes in the mask word is used in generating segment signatures and setting comparison thresholds.

An audio "'frame' signature," if such a signature is used, can be constructed in the same format as a video frame signature so that it can be processed in the same way. Such an audio signature may be used to recognize broadcast radio segments, or may be used to confirm the identification of a video segment the data for which includes a high percentage of suspect data. However, the use of audio signatures is not necessary to the invention.

The parametized "frame signature" information is stored in a circular buffer large enough to hold, preferably, approximately twice as much signal information as the longest broadcast segment to be identified. When a segment signature is being compared to the frame signature data, for each frame that passes the observation point eight comparisons between the segment signature data and the frame signature data are made, one word at a time, using the offset data stored with the segment signature to choose the frame signatures for comparison. The frame signature and segment signature words are compared using a bit-by-bit exclusive-NOR operation, which returns a 1 when both bits are the same and a 0 when they are different. The number of ones resulting from the exculsive-NOR operation is accumulated over all eight word comparisons. It is not necessary actually to construct a "parameter signature", by in fact concatenating the offset parametized frame signature words, in order to make the comparison. If the number of ones accumulated by the exclusive-NOR operation exceeds a predetermined default threshold, modified as discussed below, a match is considered to have occurred for the frame at the observation point.

Signatures are assigned to segments as follows:

A plurality, preferably eight, words are selected from the parametized segment meeting the following criteria: stable data, noise-free data, Hamming distance, and entropy.

Stable data means the word selected must have some minimum duration in the broadcast segment -- i.e., it is derived from a portion of the segment for which there are at least a minimum number of (e.g., 20 or more) frames of the same or similar data).

Noise-free data are data having an associated mask word with a maximum number of unmasked bits. (Maximization of duration or stability, and minimization of masked bits or noise, can be two competing criteria.)

Hamming distance refers to the dissimilarity of the digital data. It is desirable for more positive and reliable identification of broadcast segments that a signature for one broadcast segment differ from that for another broadcast segment by at least a minimum number of bits, known as the Hamming distance. In generating the second or any subsequent signature in the database, Hamming distance from existing signatures must be considered.

Entropy refers to the desirability, discussed above, of having the minimum possible correlation between different portions of the data. For this reason, given the preferred signature data length (8 words, 16 bits per word), preferably no two signature words should be taken from points closer together in the segment than one second. This sets a lower limit on the length of broadcast segments which can be be reliably recognized. If, e.g., eight words make up a signature, and they must be at least one second apart, the shortest segment that can be reliably recognized is a segment of approximately ten seconds in length.

Using these criteria, eight frame signatures are selected from the parametized segment and an eight-word segment signature made up of those eight frame signatures is generated and stored. The duration criterion and mask words are also stored with the segment signature for use in the recognition process. The duration parameter signifies that, because the frame data are stable for some time period, a certain number of successive matches on that data should be obtained during the recognition process. If significantly more or fewer matches are obtained, the latches are discarded as statistical anomalies. The mask data define a threshold parameter which is used during the recognition process to adjust the default number of matching bits required before a signature is considered to have matched the broadcast data. For example, a default threshold could be set for the system which, during an attempt to match a particular segment signature, is lowered by one-half the number of masked bits associated with that signature.

If the designated frame keyword lookup technique is to be used, a keyword is chosen from within the segment. Having a buffer at least twice as long as the longest segment to be identified assures that sufficient broadcast signal history to make a recognition remains in the buffer at the time the keyword reaches the observation point. The criteria used for choosing the keyword are similar to those for choosing the signature words -- it should be of stable duration and relatively noise free, augmented by the need for a "level list" -- i.e., there should be no more than about four signatures having the same keyword so that the necessary computations can be made within the the 1/30 second real-time limit.

Although using the keyword technique requires that in general only four comparisons need be made (because there are up to four signatures assigned to each keyword), additional comparisons are made to allow for the possibility of error in the parametization of the broadcast signal (occur- ring, e.g., because of noise in the transmission of the signal). Such addi-

tional comparisons lessen the probability of inaccurately recognizing a broadcast segment. If an error rate of one bit per frame signature is assumed, then in addition to the nominal keyword, sixteen additional keywords (obtained by successively complementing each different bit of the nominal keyword) are also checked. If each of the seventeen keywords checked has four signatures associated with it, then sixty-eight comparisons must be made within each 1/30 second interval. If an error rate of two bits per frame signature is assumed, then the number of keyworbs increases to

$$\sum_{i=0}^{2} \binom{16}{i} = 137,$$

requiring 548 comparisons. Given the current state of computer technology, this is still possible within the 1/30 second interval.

Before a signature can be constructed for a segment for addition to the segment signature data base, it must be determined that a broadcast segment is being received. In some cases, new segments may be played into the system manually -- e.g., where an advertiser or advertising agency supplies a video tape of a new commercial or commercials. In such a case, the operator and the system know that this is a new segment, the signature for which is not yet stored in the segment signature library. However, it can happen that a new commercial is broadcast by a local broadcast station for which no videotape was earlier supplied and which, therefore, is not yet known to the system. Therefore, the present invention also can detect the presence in the incoming signal of potential segments to be recognized that are new and presently unknown. For this purpose only (i.e., to detect but not to recognize), the present invention relies on the presence in the broadcast signal of signal artifacts characteristic of such potential unknown segments. These artifacts can include fades-to-black, audio power changes including silence ("audio fade-to-black"), and the presence (but not the content) of pre-encoded identification data appearing, e.g., in the vertical intervals of video signals. These artifacts are not assumed to indicate the presence of a new, unknown segment to be recognized per se. Rather, they are used as part of a decision-making process. For example, if two artifacts occur 30, 60 or 120 seconds apart near the hour or the half-hour, and no known segment was identified during the time between their occurrence, there is a high probability that a new and unknown segment of interest was present. On the other hand, if the interval between signal artifacts is accounted for by identified segments, the artifacts are not used or otherwise relied upon by the system and the fact that the artifacts occurred is deleted from memory. Other possible indications of the presence of new and unknown segments of interest are the occurrence of two known segments separated by 30, 60 or 120 seconds, or some other interval during which no known segments were identified, or the occurrence of one signal artifact separated in time from a known segment by such an interval. Once it is determined that a new and unknown segment of interest may be present, the parametized information derived from the unknown segment is saved along with audio and video information corresponding to the unknown segment. The signal artifacts that marked the unknown segment are not retained, nor is any record kept of what they were.

The saved audio and video information is ultimately presented, in compressed form (as discussed below), to an operator for use in identifying the new and unknown segment and recording the identi- fication in the segment signature library. The operator also records any special requirements needed to prepare a signature for the segment. For instance, some national commercials include two portions: a portion which is always the same irrespective of in which part of the country the commercial is to be broadcast (the "constant" portion), and a portion which differs depending on where the commercial is to be broadcast (the "variable" or "tag" portion). It is important to accurately identify different versions of such national commercials. If a commercial for a national product has a tag that is specific to one region, the commercial is considered different from the same commercial tagged for a different region. Therefore, the operator would note that the signature must include data from the tag portion of the segment, and that additional data must be taken from the tag. A signature is then generated automatically as described above.

The ability to differentiate between otherwise identical commercials having differing tags is one important feature of this invention. Two different approaches are used, depending on the type of tag associated with the commercial. One type of tag is known as a "live tag", which is a live-action audio/video portion of at least five seconds duration. Another type of tag is known as a "still tag" which is a still picture -- e.g., of text -- which has insufficient video content for generating a unique signature. Either type of tag can occur anywhere in the commercial.

When a live tag is involved, a separate signature is generated for the tag. The system logs both the commercial occurrences and the tag occurrences, and then merges that data with the help of pointers in the signature database. For a still tag, a flag or pointer associated with the commercial signature triggers a brute force video comparison of a frame of the tag with a frame of the reference tag or tags. This comparison is not necessarily done in real time.

A system constructed in accordance with the present invention is preferably composed of one or

more local sites and one central site. Utilizing the recognition methods described above, a local site scans one or more broadcast video and audio television signals looking for known broadcast segments. If a known segment is detected, the local site records time and date information, the channel being monitored, the identification of the segment, and other information in its database. Relying on signal artifacts, the local site also notes and records signals that it senses are likely to be new segments of interest which are not yet known to the system.

On a periodic basis, the central site communicates, e.g., via telephone lines, with the local sites to determine what known broadcast segments have been detected and what potential but unknown segments have been seen and saved, and to disseminate to appropriate local sites segment signature and detection information corresponding to new broadcast segments not yet known to those local sites. It is anticipated that the ultimate identification of a new and unknown segment will require visual or aural interpretation by a human operator at the central site.

FIG. 2 illustrates a block diagram of the system including a central site 22 and a plurality of linked local sites 21. Each local site 21 monitors broadcasting in its geographic region. Preferably, the local sites 21 are located at cable television head end stations to assure a clear input signal. The local site 21 is capable of recognizing and identifying known broadcast segments and logging occurrences of such segments by date, time, duration, channel, identification, and other desirable infor- mation. The local site is also capable of recognizing the occurrence of potentially and new unknown segments, and of generating temporary key signatures for such unknown segments so that it can maintain a log of all occurrences of each such segment pending the identification of the segment by the central site 22. Local site 21 sends to central site 22 via communications channels 23a, b all log information for recognized known segments, plus information relating to all potential new and unknown segments, and receives in return software updates, signature library updates, and requests for additional information. If a new signature transmitted to and received by one local site 21 originated as an unknown segment originally transmitted to the central site by that local site 21, the local site 21 merges the temporary log into other data awaiting transmission to central site 22, and then purges the temporary signature from its database.

One local site 21a is located at or near the central site 22 and is connected to the remainder of central site 22 by high-speed direct data line 24. This "central-local" site is identical to the other local sites 21 and serves the same function as the other local sites 21 for the broadcast market in which it and central site 22 are located. However, because central-local site 21a is connected to central site 22 by direct high-speed data link 24, new segments monitored by central-local site 21a are quickly available to central site 22 for identification. The signatures for those new segments that are of national scope can then be quickly disseminated to the remote local sites 21 to minimize the number of times a local site 21 will classify a received segment as an unknown, and thereby to prevent communications channels 23a, b from being burdened unnecessarily with the transmission of signature and other data (compressed audio and video) corresponding to locally unknown national segments.

Because the audio and video information corresponding to new and unknown segments must be transmitted to the central site 22 via comunications channels 23a, b to be reviewed by an operator during the identification process, the data is gathered by local site 21 in a compressed format to reduce communications overhead and expense.

Compression of the video data preferably is accomplished as follows. First, not every frame is captured. Preferably, only one frame every four seconds is captured to create a "slide show" effect, with an option at the request of an operator at central site 22 to capture frames more frequently. Second, as is well known, a television video frame consists of two interlaced fields occurring 1/60 second apart. In the "slide show", small motion between the fields causes a noticeable flicker. Therefore, only one field is captured, which still provides a recognizable image. Third, not all pixels are necessary for a sufficiently recognizable image. It has been found that 160 x 120 pixels is sufficient, with an option at the request of an operator at central site 22 to capture 320 x 240 pixels per field. Fourth, it is not necessary to capture color information.

Audio compression is more difficult to accomplish. Considerable information can be removed from video data while still maintaining a recognizable image. However, only a smaller amount of information can be removed from audio data without the remaining audio becoming difficult or impossible to understand, or unacceptably fatiguing for human operators. In view of this, the preferred method of audio compression is Adaptive Differential Pulse Code Modulation (ADPCM), which is used by the telephone industry and thus produces "telephone quality" audio. ADPCM techniques and circuitry are well known.

When local site 21 detects a potentially new and unknown broadcast segment, the frame signature data and the temporary segment or key signature generated for that unknown segment, and the compressed audio and video information for that segment, are stored. The local site 21 is polled periodically by central site 22 and at those times the stored frame signature data and the temporary signatures are transmitted to central site 22 for identification via communications channels 23a, b. As discussed be-

low, the audio and video information are transmitted optionally, but these data are always stored by local site 21 until the identification and signature of the segment are returned by the central site 22.

When central site 22 receives the frame signature data and temporary key signature corre- sponding to an unknown segment from the local site 21, signature co-processor 25 associated with central site 22 first checks the frame signature data against the global signature database, which contains all signatures from all local databases for all broadcast segments known to the system, to determine whether or not the "unknown" segment in fact previously had been identified and is already known to the system (perhaps because a different local site saw the broadcast segment before), but the signature for which had not yet been sent to all local sites 21 or had been identified as being of limited geographic scope and so sent to only some of local sites 21. If the unknown frame signature data match a signature in the global database, the global signature for that segment (which may differ somewhat from the temporary signature) is transmitted back to the originating local site, and the originating local site 21 is instructed to replace the temporary key signature generated locally with the global key signature. If the frame signature data are not matched to a signature in the global database, the corresponding temporary key signature is added to a separate portion of the global database used to store temporary signatures. This "temporary global data-base" allows coprocessor 25 to carry out the grouping of like unknowns, previously discussed, because if the same unknown comes in from another local site 21 it should be matched by the temporary signature stored in the global database, thereby indicating to copro- cessor 25 that it is probably the same segment which has already been sent by another local site 21.

At the same time that the temporary signature for a new segment is stored by coprocessor 25 in the global database, coprocessor 25 causes host computer 27 to request the compressed audio and/or video data from local site 21 if those data have not already been transmitted. For economy in communications, audio and video data preferably are not initially transmitted from local sites 21 on the theory that the frame signature data may be identified as a known segment upon comparison to the global database. However, for some "hot" markets where new segments frequently originate (e.g. Chicago, Los Angeles and New York), the audio and/or video data may also have already been sent for another segment in the group. Further, audio and video need not both necessarily be transmitted. For some new and unknown segments, perhaps only the audio, or only the video, can enable the identification, while for other new and unknown segments both will be necessary. If no data for the audio or video had been sent, the operator will request one set of data. In this case, unknown segment data are stored until the missing audio or video data arrive, and then queued to an operator workstation 26. If the operator determines that the audio (if only video was sent) or video (if only audio was sent) data are also needed, the unknown data are again stored until the missing information arrives, when the data are requeued. Similarly, the operator may determine that higher resolution video (320 x 240 pixels or more frames per second) is needed and the unknown data again are stored. In a case where high resolution video is requested, if local site 21 always captures the high resolution video and simply does not transmit it for purposes of economy, it can be transmitted quickly on request. However, the system may be implemented in such a way that local site 21 does not routinely capture the high resolution video, in which case it is necessary to wait until the segment is broadcast again in that locality.

Once the operator has all of the necessary information, he or she then plays back the audio and/or video information to identify the unknown segment, specifying any special requirements for signature generation as discussed above. The operator may also determine that the information captured as a result of the signal artifacts is actually two segments (e.g., in a 30-second interval, two 15-second commercials occurred), or that two consecutive intervals were each half of a single segment (e.g., two 30-second segments represent one 60-second commercial). In such a case, the operator instructs the system to break up or concatenate the segments, recreate the frame signature and segment signature data, and restart the identification process for the resulting segment or segments.

After an operator has identified the seg- ment, the frame signature data for each segment in the group must be aligned with the frame signature data for each other segment in the group before a global key signature can be constructed. Alignment is necessary because different segments in the group may have been captured by local sites 21 by the detection of different artifacts. Thus, the segments may not all have been captured identically -- i.e., between the same points. For example, a set of segment data in a group for a broadcast segment nominally 60 seconds in length may in fact, as captured, be only 55 seconds in length because the segment was broadcast incompletely. Or, a member segment of the group may be too long or too short because it was captured as a consequence of the detection of a fade-to-black artifact or of an audio power change artifact.

Alignment is carried out by coprocessor 25. First, the frame signature data for the first segment in the group are placed in a buffer. Next, data for a second segment are clocked word-by-word into another buffer and an exclusive-NOR between all bits of the two segments is continually performed as the second

segment is clocked in. When the aggregate number of ones returned by the exclusive-NOR is at a maximum (meaning that the compared bits are the same -- either zeroes or ones), alignment has been achieved. The aligned data then are used as a base-line to align the remaining segments in the group. The alignment process is time-consuming. However, it is not necessary that alignment be done on real-time basis. Preferably, alignment is performed at night, or at some other time when system activity is at a low point.

Once the parametized data for all segments within a group have been aligned, a best fit of both the frame signature data and the mask data is calculated by assigning to each bit position the value of that bit position in the majority of segments. The signature coprocessor 25 then generates a new global signature for the segment using the best fit parametized data.

After the new global signature has been generated, it is compared to the frame signature data for all of the unknown segments in the group to which it applies to make certain that the data for each segment matches the signature. If the new global signature does not latch each set of frame signature data, this signifies either that an error was made in selecting the keyword or another of the data words, or that one or more sets of data in the group are really not representative of the same segment. In such a case, an operator may have to view additional segments in the group.

If the new global signature matches each grouped segment, the signature is transmitted back to each local site 21 or to an appropriate subset of local sites if the newly identified segment is not of national scope. The respective local sites 21 then merge the data they had been keeping based on the temporary signatures and send it to central site 22, replace the temporary signatures they had been retaining with the new global signature in their local databases, and purge the audio, video, and frame signature data for that segment.

II. Preferred Embodiments

A first preferred embodiment of a local site 30 is shown diagrammatically in FIG. 3, and includes an IBM PC personal computer 31 and two Intel 310 computers 32 33, interconnected by conventional RS-232C serial links 34, 35. Personal computer 31 uses a circuit card 36 and a software program to extract video parameter data from incoming video signals. Computer 32 creates signatures for new and unknown segments and matches existing signatures maintained in a signature library against incoming frame signature data. Computer 33 logs the "hits" or matches made by personal computer 32.

A frame grabber card 36, such as the PC Vision Frame Grabber by Imaging Technologies, in personal computer 31 generates 512 x 256 pixels for each frame of incoming video information. However, frame grabber 36 is utilized so that only one field per frame is sampled. Frame grabber 36 also provides a video field clock that is used by computer 31. Computer 31 processes the frame grabber output to produce a four-bit word representing each frame. A flow chart of a computer program used in personal computer 31 is shown in FIG. 4. The flowchart will be readily understood by those of ordinary skill in the art.

The parametized data from personal computer 31 are transmitted over serial link 34 to computer 32 where they are clocked into a section of RAM partitioned, using pointers, as a modulo-2048 circular buffer. The buffer holds 34 seconds of data. Frame grabber 36 and personal computer 31 are too slow to grab all of the frame data in real time (although in the second preferred embodiment, described below, this function is performed by hardware which does operate in real time). Resultantly, some data are lost. However, the data that are provided over serial link 34 are inserted into the buffer in their current real-time positions. Computer 32 "backfills" the buffer by filling in the empty positions with the next succeeding real time data. Computer 32 creates signatures and matches incoming frame signature data to a signature data-base as described above, without using the designated frame keyword lookup technique. A flowchart of the signature generation program is shown in FIG. 5. A flowchart of the signature detection program is shown in FIG. 6. The flowcharts will be readily understood by those of ordinary skill in the art.

For the purposes of creating signatures in this embodiment, each segment is divided into nine sections -- a half-section at the beginning, followed by eight full sections, and a half-section at the end. The two half-sections are discarded to account for possible truncation of the beginning or end of the segment when it is broadcast. A word is then selected, using the previously described criteria of stable data, noise-free data, Hamming distance, and entropy, from each of the eight sections. The signatures created are stored in the memory of computer 32 while the match data are transmitted over serial link 35 to computer 33 which keeps track of the matches. A flowchart of a program used in computer 33 is shown in FIG. 7. The flowchart will be readily understood by those of ordinary skill in the art.

Signatures are generated in the system of FIG. 3 by the computer 32. However, the generation of signatures is not initiated as earlier described and as implemented in the second preferred embodiment (described below). Rather, in the system of FIG. 3, an operator must "prime" the system by specifying the segment length, playing a tape into the system and manually starting the buffer filling process. Computer 32 then builds a signature automatically. However, there

is no threshold or guard-band computed here as was earlier described, and as implemented in the second preferred embodiment (described below). In the second preferred embodiment, a threshold asso- ciated with the signature is modified by subtracting from the default threshold one-half the number of masked bits in the signature, while in the system of FIG. 3 the default threshold is augmented at the time of comparison by one-half the number of masked bits in the data being compared.

A second preferred embodiment of the system of the invention is shown in FIGS. 8-12.

FIGS. 8-11B show the details of local sites 21. FIG. 8 is a block diagram of local site 21. The local site 21 is comprised of two major subsystems: the signal processing subsystem 80 and the control computer 81.

The signal processing subsystem 80, shown in more detail in FIG. 9, receives incoming RF broadcast signals and performs three distinct tasks:

1. It recognizes "known" broadcast segments by comparing received frame signature data to local library of segment signatures;
2. It detects artifacts in the received broadcast signal for the purpose of delineating and capturing potential "unknown" broadcast segments whose frame signature data do not match any locally stored segment signature; and
3. It collects data (e.g., compressed video and audio, time of day, and so forth), to allow subsequent identification of "unknown" segments by an operator at the central site. Hardware performs much of these tasks to provide maximum speed of operation. In addition, software-driven microprocessors cooperate with the hardware to assist with the lower speed portions of these tasks and to allow programmability and flexibility.

The hardware of signal processing subsystem 80 includes matching module 82, compression module 83, and one or more tuners 84 (there is one tuner for each broadcast station to be monitored). Tuner 84 may be any conventional RF tuner, and in the preferred embodiment is Zenith model ST-3100. Matching module 82 and compression module 83 are built around the well-known Intel Corporation Multibuse II Bus Structure. Multibuse II is described in the Multibuse II Bus Architecture Databook (Intel Order No. 230893) and the Multibuse II Bus Architecture Specification Handbook (Intel Order No. 146077C), both of which are incorporated herein by reference. The first two tasks discussed above are performed in matching module 82. The third task is performed in compression module 83.

Each of the two modules 82, 83 includes a Central Services Module (CSM) 90 which is a standard off-the-shelf item (such as Intel Order No. SBC-CSM-001) required in all Multibuse II systems. Each module also has an executive microcomputer board 91a, 91b which controls communications between the respective module and control computer 81. All components on each module are interconnected on public bus 92, while those components which require large amounts of high-speed data transfer between them are additionally interconnected by private bus 93.

Matching module 82 further includes one channel card 94 for each channel to be monitored -- e.g., one for each commercial station in the local market. Channel cards 94 generate the 16 bits per frame of parametized signal data and the corre- sponding 16-bit mask for both audio and video in accordance with the methods earlier described. Channel cards 94 also signal the occurrence of signal artifacts which indicate, and are used to delineate and capture, potential unknown segments. Also contained within matching module 82 are two circular buffer memories 95. One buffer 95 is for audio and the other is for video. These buffers store on a temporary basis the incoming parametized frame signature data, as earlier described. In this preferred embodiment, the maximum length of broadcast segments to be recognized is assumed to be one minute. For longer segments, only a one-minute portion is used for recognition purposes. Accordingly, each buffer can hold 4,096 frames, which is 136.5 seconds, of video at a frame rate of thirty frames per second, or just over two minutes. 4,096 is 2^{12}, so the offset data associated with each sig- nature (as earlier described) is 12 bits long. Parametized signal information is moved from channel cards 94 to the circular buffers 95 when requested by executive microcomputer 91a.

Matching module 82 also includes correlation card 96, shown in more detail in FIG. 10. Correlation card 96 performs the task of recognizing incoming broadcast segments. Correlation card 96 accomplishes this by comparing incoming video and audio frame signature data with the locally stored database of key signatures to find matches. The local signature database is stored in memory 97 (up to 13 megabytes of conventional random access memory). Since correlation card 96 in the preferred embodiment may operate on both audio and video data (although, e.g., only video can be used), correlation card 96 must have sufficient capacity to process an amount of data equivalent to twice the number of channels to be monitored.

Correlation card 96 performs all functions required to generate the raw data for the final correlation, or determination of a segment match. Executive microcomputer 91a accumulates the matches resulting from key signature comparisons done by correlation card 96, and then transmits the accumulated matches to control computer 81.

As shown in FIG. 10, correlation card 96 contains signature comparison processor (SCP) 101 and two independent interfaces 102, 103 to the Multibuse II

public and private buses. SCP 101 is a programmable element which operates under command of executive microcomputer 91a. SCP 101 is responsible for the following primary functions:

1. Generation of all addresses to data-base memory 97 for the purpose of accessing key signatures, current circular buffer data, and segment signatures (the latter when this card is used in the coprocessor as described below);
2. Performing the actual bit-by-bit comparison of frame signature data and stored segment signatures;
3. Execution of self-test diagnostic functions as requested by executive micro- computer 91a; and
4. Relaying results of each key signature comparison to the executive microcomputer 91a for final segment correlation.

Control unit 104 of SCP 101 directs the operation of SCP 101. Control unit 104 includes memory which contains all microprogram instructions defining SCP operation. It also contains sufficient functionality to allow for the efficient sequencing of the required microinstructions. Control unit operation is directed, at an upper level, by instructions generated by executive microcomputer 91a.

Logic unit 105 performs all address and data manipulations required to load both incoming and previously defined reference signatures into onboard buffers for comparison. Signature data is resident in external, offboard memory accessible by the private bus; logic unit 105 and control unit 104 together execute all private bus interface functions.

Logic unit 105 also generates messages to and interprets messages from executive microcomputer 91a. An example of a message interpreted by logic unit 105 is a request to compare selected key signatures in the key signature database to the current, incoming segment signature. An example of a message generated by logic unit 105 is that which is generated at the end of a comparison which defines how well the incoming signature matches the reference (how many total correct or incorrect bits after comparison).

The logic unit peripheral hardware module 106 is responsible for assisting logic unit 105 in performing signature comparisons. Specifically, the module contains logic which is intended to increase the processing capability of SCP 101. The features of module 106 are:

1. Programmable memories which contain constant data;
2. Word swap hardware which allows information in internal logic unit registers to be positionally exchanged at high speed; and
3. Hardware which counts the number of active bits in a preliminary signature comparison result, in preparation for testing against a predetermined threshold.

Executive microcomputer 91a is a standard commercial microcomputer card (e.g., Intel Order No. SBC-286-100) based on an 80286 microprocessor. The function of this card is to:

1. Maintain the signature data base;
2. Transfer data from the channel cards to the circular buffers;
3. Maintain the keyword pointers;
4. Accumulate the correlation results (for use in applying the duration criterion);
5. Capture data for segment identification; and
6. Provide an interface path to the control computer 81. (All data to be transferred to central site 22 is requested by control computer 81. The key signature database is down-loaded from control computer 81.)

Compression module 83 includes (in addition to central services module 90 and executive microcomputer 91b) audio capture card 98a, video capture card 98b, and associated circular buffer memories 99a, 99b. The audio and video capture cards are shown in more detail in FIGS. 11A and 11B, respectively.

Audio and video capture cards 98a, 98b each can monitor up to eight broadcast channels (monitoring more channels requires multiple cards). Video card 98b captures incoming video frames at a slide-show rate of one frame per second and digitizes and compresses the video data, while audio card 98a digitizes and captures audio continually, for each of the eight channels.

The audio and video from up to eight channels are brought to these cards (as well as to the channel cards) from channel tuners 84 by coaxial cables. On video capture card 98b, a conventional 1-of-8 multiplexer 110 (implemented in this embodiment as a T-switch circuit design using CMOS 4066 integrated circuits), selects one of the eight channels for capture.

As shown in FIG. 11A, on audio card 98a, the audio from each channel is fed to one of up to eight combination filter/coder/decoder circuits 111, such as a National Semiconductor 3054 integrated circuit. In combination circuit 111, the audio signal is passed through a low-pass filter and then through a coder/decoder which performs a logarithmic analog-to-digital conversion resulting in a digital signal with a compressed amplitude (the audio signal is expanded again prior to being audited by an operator at central site 22). The compressed digital signal is then passed through an adaptive differential pulse code modulator (ADPCM) 112 similar to that used by the telephone industry -- e.g., a NEC 7730 integrated circuit -- for further compression. An Intel 80188 microprocessor 113 controls the movement of the compressed audio data from ADPCM 112 through bus interface 114 to private bus 93 of compression module 83, and thence to circular buffer memory 99a. A JEDEC-standard RAM-/EPROM 113a contains programs and memory workspace used by microprocessor 113.

As shown in FIG. 11B, on video card 98b, common video circuit 115 uses the sync information contained in the received analog video signal to generate clock pulses and addresses for analog-to- digital conversion of the video signal. Circuit 115 outputs both address signals and digitized data signals representing the video at the rate of one field per second at 116 and 117, respectively. The data pass to arithmetic logic unit (ALU) 118 which further compresses the video data by reducing each video field or frame to 160 (horizontal) by 120 (vertical) pixels, each pixel averaging four-by-two pixel areas in size, using gray scale pixel averaging. The address data pass from common video circuit 115 to dither prom 119 which contains a table of pseudorandom numbers -- one for each video address output by circuit 115. When an address is received by dither prom 119, the pseudorandom number associated with that address is passed to ALU 118 to be added to the compressed video data. This dithering technique, by which a low-information-content video signal can be visually improved, allows the video frame to be compressed to as few as 9600 bytes. The dithered compressed video data are then passed to one of two line buffers 1101a, b (one buffer is filled while the other is being read and emptied), from which they are passed under the control of direct memory access controller 1102 to private bus 93 of compression module 83, and thence to circular buffer memory 99b.

The audio and video data are placed in circular buffers 99a and 99b holding the most recent two minutes of data for that channel under the direc- tion of control computer 81 and executive microcomputer 91b. Executive microcomputer 91b preferably is a standard commercial microcomputer card (e.g., Intel order No. SBC-286-100) based on an 80286 microprocessor. This card provides an interface path to the control computer 81. All data to be transferred to the central site is requested by control computer 81.

The signal processing subsystem 80 can be referred to as the "front end" of local site 21. Control computer 81 can be referred to as the "back end".

Control computer 81 (FIG. 8) is preferably a commercially available MicroVAX II minicomputer manufactured by Digital Equipment Corporation (DEC), running the DEC VMS virtual memory operating system. Between one and nine megabytes of RAM memory are provided along with one DEC RA81 Winchester disk drive (with controller) having a capacity of 456 megabytes. A DPV11 synchronous interface connects the control computer 81 to communications channels 23a, b via a modem. A DRV11 direct memory access controller connects control computer 81 to signal processing subsystem 80.

A function of control computer 81 is to determine, using detected signal artifacts, when new and as yet unknown broadcast segments may have been received. Control computer 81 also keeps track of the temporary log for such segments until the segments have been identified by central site 22. Another function of control computer 81 is to determine, based on duration and other criteria, such as time of day, whether or not matches accumulated by executive microcomputer 91a actually indicate that a segment has been recognized. (For example, during "prime time" no commercials are normally broadcast at, e.g., 7 minutes after the hour.) In performing these functions, control computer 81 exercises its ability to control all segment processing subsystem 80 functions via executive microcomputers 91a, 91b.

Control computer 81 can instruct modules 82 and 83 to tune to a particular channel to capture audio/video data, to compare a pair of frame and key signatures, or to generate a local signature. These instructions can originate in control computer 81 itself or ultimately at central site 22. For example, in identifying a new segment, an operator may need higher resolution video information. In such a case, control computer 81 would act on instructions from central site 22 by requesting module 83 to capture the required data when the desired segment is next received. Control computer 81 also stores on disk a backup copy of the signature database stored in RAM memory 97.

Referring again to FIG. 2, central system 22 includes central-local site 21a, coprocessor 25, mainframe "host" computer and memory 27 with associated mass storage device 28, communications processor 29 and workstations 26.

Coprocessor 25 is used to assist with certain computationally intensive functions related to the signature processing requirements of the central site 22. The "front end" of coprocessor 25 is identical to matching module 82 of local site 21, earlier described, except for the omission from coprocessor 25 of channel cards 94. It is preferred, however, that the memory for the signature database within coprocessor 25 be expanded over that of the local site to ensure that all key signatures used at all local sites can be resident in coprocessor 25.

The "back end" of coprocessor 25 preferably uses the same MicroVAX computer used by local sites 21 (FIG. 8), although a different type of computer could be used. Another alternative is that the coprocessor front end may be attached to communications processor 29 at the central site. It is also preferred that the coprocessor hardware be duplicated at central site 22 so that a backup system is available in case of a failure of the primary coprocessor. The coprocessor's signature generating and comparing functions are performed in the front end, while its checking and grouping functions are controlled by its back end utilizing the comparison capabilites of the front end as described above.

Workstation 26 is the vehicle by which new and unknown segments are presented to, and classified by, human operators. A secondary function of work-

station 26 is to act as a terminal in the maintenance of host resident databases. Workstation 26 is made up of the following:

1. A standard IBM 3270 AT computer capable of local processing and communicating with host computer 27;
2. A 30 MB hard disk drive, 1.2 MB floppy drive, color console monitor and keyboard all attached to the 3270 AT;
3. Two video monitors for viewing two segments simultaneously;
4. One audio output device (e.g., headphones) for listening to the audio portion of a segment;
5. A video card installed in the 3270 AT for controlling the video portions of segments; and
6. An audio card installed in the 3270 AT for controlling the audio portion of segments.

The heart of workstation 26 is the IBM 3270 AT computer. The 3270 AT is a blend of an IBM 3270 terminal and an IBM AT personal computer. By combining the power of these components, a very effective mainframe workstation is created. Workstation 26 allows easy communication with host 27 and has its own processing capability. Up to four sessions with host 27 can be started as well as a local process all viewed in separate windows on the console screen. A combination of host and local processes are used by the operator.

The video card contained in the 3270 AT can display two different segments. Each video card consists of a pair of "ping-pong" (A/B RAM) memories for holding compressed gray scale video data. The ping-pong memories can be used in one of two ways. First a segment can be pre-loaded into RAM A while RAM B is being displayed. Second, the ping-pong memories can be used to load the next frame of a segment while the other is being displayed. Gray scale data is returned to video format and smoothed before being passed through the video digital-to-analog converter.

An audio control card is also provided in the 3270 AT. ADPCM circuits (e.g., NEC 7730) on the audio control card expand the data and output a serial bit stream for conversion to analog information to be played on the operator's headphones.

Workstation 26 supports the identification process of new commercial segments and contains self-test routines to check the status of the machine and components. It is possible for workstation 26 to operate in a somewhat stand-alone mode requesting needed information from host 27 and passing results back. Alternatively, host 27 could control the application and send audio/video requests to work-station 26. The operator at workstation 26 controls the audio and video cards to cause the audio and/or video portions of selected segments to be displayed or output.

Host computer 27 is preferably an IBM mainframe of the 308X series, such as an IBM 3083. Host computer 27 maintains a copy of the global signature databast and an archive of all parametized and compressed audio/video data from which the signature database was generated. The archive allows recreation of the signature database in the event, e.g., of an accidental catastrophic loss of data.

Host computer 27 uses the following commercially available software packages:

1. Operating system -- IBM MVS/XA;
2. Communications software -- IBM ACF/VTAM, MCP, MPAA;
3. Telecommunications monitor -- IBM CICS; and
4. Database management system -- Cullinet IDMS.

Host 27 also commands the workstation 26, coprocessor 25 and, ultimately, local site 21. For example, it may be determined that additional information is needed from a particular local site 21. Host 27 acts on that determination by instructing the appropriate local site control computer 81 to request that its signal processing subsystem 80 capture additional data, or upload some data previously captured, for example.

Host 27 also uses information transmitted by the various local sites 21 as to the occurrences of segments to compile a log of occurrences and one or more reports requested by the system users.

Communications channels 23a, b and communications processor 29 are shown diagrammatically in more detail in FIG. 12. In the embodiment shown, coprocessor 25 has a separate control computer 121, although, as stated above, the functions of that computer could be handled by communications processor 29.

All communications within central site 22 and local sites 21 are coordinated by Digital Equip- ment Corporation (DEC) equipment. Therefore, communications throughout the system are based on DEC's DECNet protocol. Within central site 22, the DECNet protocol is run on a local area network 120. An SNA gateway 122 manufactured by DEC is connected to local area network 120 to translate between DECNet and IBM's Systems Network Architecture to allow communications between host 27 and the rest of the system. An IBM 3725 communications control device 123 interfaces between SNA gateway 122 and host 27. An IBM 3724 cluster controller 124 interfaces between device 123 and workstations 26, allowing workstations 26 to communicate with host 27. Central-local site 21a is connected to local area network 120 by high-speed link 24 as earlier discussed.

Communications control computer 29 is preferably a Digital Equipment Corporation VAX 8200. Coprocessor control computer 121 is the identical computer and in fact, as discussed above, its function can be performed by communications control computer 29 if desired.

Communications control computer 29 interfaces between local area network 120 and local sites 21. For local sites 21 with which high-speed or high-

volume communications is necessary or desired -- e.g., major "hot" markets such as New York, Chicago or Los Angeles -- communication can be by high-speed leased line 23b. However, for most local sites 21, a lower speed packet switching data network 23a running the well-known X.25 protocol is used. The X.25 protocol is transparent to DECNet and is available on such commercial data communications networks as Telenet or Tymnet. Communication lines 125 between individual local sites 21 and network 23a can be provided either by leased line or over the telephone dial-up network.

Thus it is seen that a method, apparatus and system has been provided for accurately (with a less than 1% error rate), rapidly and reliably logging the occurrences of large numbers of broadcast segments without relying on cues or codes in the signal, and for identifying new segments with a minimum of human involvement.

Persons skilled in the art will appreciate that the present invention can be practiced by other than the embodiments described herein, which are presented for the purpose of illustration and not of limitation, and the present inventton is limited only by the claims that follow.

Claims

1. A method for continuous pattern recognition of broadcast segments, said method comprising:

   constructing a digital signature from a known sample of a segment to be recognized by digitally parametizing said segment, selecting portions (1_1 to 1_{16}) from among random frame locations throughout said parametized segment in accordance with a set of predefined rules to form said signature, and associating with said signature the frame locations of said portions relative to a reference location;

   storing said signature and associated frame location information in a library of signatures, each signature in said library being identified with a particular segment to be recognized;

   monitoring a broadcast signal;

   digitally parametizing said monitored signal on a frame-by-frame basis;

   for each frame (10) of said parametized monitored signal, searching said library for a signature potentially associated therewith and, using the frame location information associated with said potentially associated signature, comparing said potentially associated signature to the appropriate frames (10) of said parametized monitored signal.

2. The method of claim 1, wherein:

   the step of constructing a digital signature from a known sample of a segment to be recognized comprises digitally parametizing said segment by forming a string of digital words each representing one frame of said segment, identifying a word representing a designated frame in said segment, the association with said segment of the word representing
   said designated frame being nonexclusive, identifying the offsets of said frame locations relative to said designated frame, and selecting a plurality of additional words each representing a respective one of the frames at said frame locations;

   the step of storing said signature and frame location information comprises storing the word representing said designated frame and said plurality of additional words along with information representing the offsets of said frame locations relative to said designated frame;

   the step of digitally parametizing said monitored signal comprises forming a plurality of monitored digital words each representing a frame of said monitored signal; and

   for each frame of said parametized monitored signal, the step of searching said library comprises searching said library for any signature for which the monitored digital word representing said frame also represents said designated frame, and comparing the additional words of any such signature with the words of said parametized monitored signal at said offsets relative to said monitored digital word.

3. The method of either of claims 1 or 2, wherein said signature and parametized monitored signal are derived from video portions of said segment and said monitored signal.

4. The method of either of Claims 1 or 2, wherein said signature and parametized monitored signal are derived from both audio and video portions of said segment and said monitored signal.

5. The method of Claim 3 wherein said signature and said parametized monitored signal are derived from luminance values of said video portion.

6. The method of Claim 5 wherein said signature and said parametized moniored signal are derived by comparing average luminances of selected areas (1_1 to 1_{16}) of a frame (10) of said segment and monitored signal, respectively, to an average luminance of at least one reference area, each of said selected areas (1_1 to 1_{16}) providing a bit of respective one of said signature and said parametized monitored signal.

7. The method of Claim 6 wherein said selected areas (1_1 to 1_{16}) are asymmetrically spaced about the center of said frame (10).

8. The method of either of Claims 6 or 7 wherein said at least one reference area is said entire frame (10).

9. The method of either of Claims 6 or 7 wherein said at least one reference area is, for each of said selected areas (1_1 to 1_{16}), a different preselected area of said frame (10).

10. The method of either of Claims 6 or 7 wherein said at least one reference area is, for each of said selected areas (1_1 to 1_{16}), the corresponding area of a previous frame.

11. The method of either Claims 6 or 7 wherein said at least one reference area is, for each of said selected areas (1_1 to 1_{16}), a different preselected area ($1'_1$ to $1'_{16}$) of a previous frame (10).

12. The method of claim 4 wherein said signature and said parametized monitored signal are derived at least in part from a frequency spectrum of said audio portion.

13. The method of claim 12 wherein said signature and said parametized monitored signal each comprise a plurality of digital words, each digital word of said signature and said parametized monitored signal being derived by comparing selected frequency bands of said audio portion to at least one reference band, each of said selected bands providing a bit of said digital word.

14. The method of any preceeding claim, further comprising reducing the amount of data on which said searching step is performed by selecting less than all of the data of the stored signatures to be searched.

15. The method of claim 14 wherein said data reduction step comprises associating a digital word representing a designated frame of said segment with the signature of said segment, said association being nonexclussive, the step of digitally parametizing said monitored signal comprises forming a plurality of digital words each representing a frame of said monitored signal, and said searching step comprises, for each digital word in said parametized monitored signal, searching said library for any stored signature for which said digital word in said parametized nonitored signal corresponds with said digital word representing said designated frame.

16. The method of any preceding claim wherein each of said segments includes a constant portion and a variable portion; and where said signature is constructed from a known sample of the constant portion of such a segment to be recognized; said method further comprising:

recording additional data from known samples of said variable portion;

storing said additional data with said signature;

associating with said stored signature an indication of the existence of said variable portion;

using said additional data to identify the variable portion of a broadcast segment once the constant portion has been identified.

17. The method of Claim 16 wherein:

said step of recording additional data comprises constructing a second signature for said variable portion; and

said using step comprises identifying the variable portion of said broadcast segment with said second signature.

18. The method of Claim 16 wherein:

said step of recording additional data comprises recording at least one video frame of said variable portion; and

said using step comprises performing a direct comparison of said at least one video frame and at least one frame of said monitored broadcast signal.

19. Apparatus for continuous pattern recognition of broadcast segments, said apparatus comprising:

means for constructing a digital signature from a known sample of segment to be recognized by digitally parametizing said segment, selecting portions (1_1 to 1_{16}) from among random frame locations throughout said parametized segment in accordance with a set of predefined rules to form said signature, and associating with said signature the frame locations of said portions relative to a reference location;

means for storing a library of signatures and associated frame location information, each signature, in said library being identified with a particular segment to be recognized;

means for monitoring a broadcast signal;

means for digitally parametizing said monitored signal on a frame-by-frame basis; and

means for searching said library for a signature potentially associated with each frame (10) of said parametized monitored signal and, using the frame location information associated with said potentially associated signature, for comparing said potentially associated signature

to the appropriate frames (10) of said parametized monitored signal.

20. The apparatus of claim 19 wherein:

said constructing means is operative to digitally parametize said segment by forming a string of digital words, each of said words representing one frame (10) of said segment, said constructing means being further operative to identify a word representing a designated frame (10) in said segment, the association with said segment of the word representing said designated frame (10) being nonexclusive, and select a plurality of additional words each representing a respective one of the frames (10) at said random frame locations;

said storing means being operative to store in said library of signatures the digital words representing said designated frame (10) and said additional frames (10) along with offsets of said additional frames relative to said designated frame;

said means for digitally parametizing said monitored signal is operative to form a string of monitored digital words each representing a frame (10) thereof; and

said searching means is operative to search said library for a signature for which a monitored digital word represents said designated frame (10) and to compare the additional words of any such signature with the words of said parametized monitored signal at said offsets relative to said monitored digital word.

21. The apparatus of either of claims 19 or or 20 wherein said constructing means operates on a video portion of said segment.

22. The apparatus of either of claims 19 or 20 wherein said constructing means operates on both audio and video portions of said segment.

23. The apparatus of any of claims 19 to 22 wherein each of said segments includes a constant portion and a variable portion; and where said signature is constructed from a known sample of the constant portion of such a segment to be recognized; said apparatus further comprising:

means (82, 83) for recording additional data from known samples of said variable portion;

means (81) for storing said additional data with said signature;

means (26) for associating with said stored signature an indication of the existence of said variable portion; and

means (82) for using said additional data to identify the variable portion of a broadcast segment once the constant portion has been identified.

24. The apparatus of Claim 23 wherein:

said recording means comprises means (82) for constructing a second signature for said variable portion; and

said using means comprises means (82) for identifying the variable portion of said broadcast segment with said second signature.

25. The apparatus of Claim 23 wherein:

said recording means comprises means (83) for recording at least one video frame of said variable portion; and

said using means comprises means for performing a direct comparison of said at least one video frame and at least one frame of said monitored broadcast signal.

26. The apparatus of any claims 19 to 25 further comprising:

means for detecting, in said monitored signal, the occurrence of artifacts characteristic of potential unknown segments to be recognized; and

means for classifying and identifying said potential unknown segments.

27. A system for continuous pattern recognition of broadcast segments, incorporating apparatus as claimed in claim 26 and comprising:

a communications network (23a, 23b, 29) linking a central site (22) and a plurality of local sites (21) located in different geographic regions for monitoring broadcast signals in said regions;

each of said local sites (21) has at least said storing means, said digitally parametizing means, said searching means, and said detecting means, said storing means containing a local library of segment signatures applicable to broadcast signals in its geographic region;

said central site (22) has said constructing means and storing means containing a global library containing all of the information in all of said local libraries; and

said classifying and identifying means comprises:

means at each of said local sites (21) for generating compressed audio and video information, a temporary digital signature, and parametized monitored signal information for a potential unknown segment not found in the respective local library and for transmitting at least said parametized monitored signal information and said temporary digital signature for a potential unknown segment via said communications network to said central site (22);

means (25) at said central site for searching and comparing signatures stored in said global library with said transmitted parametized monitored signal information;

means (25) at said central site (22) for grouping together like potential unknown segments received by said central site (22) from said local sites (21) and not found in said global library;

means (27) at said central site (22) for requesting at least one of said compressed audio and video information for at least one of said grouped potential unknown segments and for allowing an operator to play back said at least one of said audio and video information to classify said segment and to instruct said constructing means (25) to automatically construct a signature for said segment; and

means for adding said signature constructed by said constructing means at said central site (22) to said global library and for transmitting it via said communications network (23a, 23b, 29) to said local libraries.

28. The system of claim 27 wherein said grouping means comprises:

means (25) for comparing the temporary digital signatures of other potential unknown segments to a parametized potential unknown segment;

for all potential unknown segments matching a given temporary digital signature, means for temporally aligning the parametized monitored signal information of said segments; and

means for constructing a best fit to said aligned parametized monitored signal information.

29. The system of either of claims 27 or 28, further comprising means for transmitting from each of said local sites (21) to said central site (22) information concerning the occurrence of broadcast segments and means at said central site (22) for logging said information.

30. The system of claim 29 further comprising means at said local site (21) for storing the temporary digital signature of a potential unknown segment and for logging the occurrences of said potential unknown segment based on said stored temporary signature as log information, and means for transmitting said log information to said central site (22) after said central site (22) has identified said potential unknown segment.

Patentansprüche

1. Verfahren zur kontinuierlichen Mustererkennung von Sendesegmenten, wobei das Verfahren aufweist:

Aufbau einer digitalen Signatur aus einer bekannten Probe eines zu erkennenden Segmentes durch digitales Parametrisieren des Segmentes, Auswählen von Teilen (1_1 bis 1_{16}) von statistischen Bildpositionen aus dem parametrisierten Segment in Übereinstimmung mit einem Satz vordefinierter Regeln zur Bildung der Signatur und Zuordnen, zur Signatur, der Bildpositionen der Teile relativ zu einer Bezugsposition,

Speichern der Signatur und der zugeordneten Bildpositionsinformation in einer Signaturbibliothek, wobei jede Signatur in der Bibliothek mit einem speziellen zu erkennenden Segment identifiziert ist,

Überwachen eines Sendesignales,

digitales Parametrisieren des überwachten Signals auf bildweiser Basis,

für jedes Bild (10) des parametrisierten, überwachten Signals, Durchsuchen der Bibliothek nach einer zu potentiell zugeordneten Signatur unter Verwendung der Bildpositionsinformation, die mit der potentiell zugeordneten Signatur verbunden ist, Vergleichen der potentiell zugeordneten Signatur mit den geeigneten Bildern (10) des parametrisierten, überwachten Signals.

2. Verfahren nach Anspruch 1, wobei:

der Schritt des Aufbaus einer digitalen Signatur aus einer bekannten Probe eines zu erkennenden Segments das digitale Parametrisieren des Segmentes durch Bildung einer Folge von digitalen Worten umfaßt, von denen jedes einem Bild des Segments entspricht, die Identifizierung eines Wortes, das ein bezeichnetes Bild in diesem Segment angibt, wobei die Zuordnung zum Segment des Wortes, das das bezeichnete Bild angibt, nichtexklusiv ist, die Identifizierung des Offsets der Bildpositionen relativ zu dem bezeichneten Bild und das Auswählen einer Anzahl von zusätzlichen Wörtern, von denen jedes jeweils eins der Bilder in den Bildpositionen angibt,

wobei der Schritt des Speicherns der Signatur und der Bildpositionsinformation das Speichern des Wortes umfaßt, das das bezeichnete Bild angibt, und der Vielzahl von zusätzlichen Wörtern zusammen mit Information, die die Offsets der Bildpositionen relativ zu dem bezeichneten Bild angibt,

wobei der Schritt des digitalen Parametrisierens des überwachten Signals das Ausbilden einer Vielzahl von überwachten Digitalwörtern umfaßt von denen jedes ein Bild des überwachten

Signals angibt, und

wobei für jedes Bild des parametrisierten überwach- ten Signals der Schritt des Durchsuchens der Bibliothek das Durchsuchen der Bibliothek nach jeder Signatur umfaßt, für die das überwachte Digitalwort, das das Bild angibt, ebenfalls das bezeichnete Bild angibt und das Vergleichen der zusätzlichen Wörter jeder derartigen Signatur mit den Wörtern des parametrisierten überwachten Signals mit Offsets relativ zu dem überwachten Digitalwort.

3. Verfahren nach einem der Ansprüche 1 oder 2, wobei die Signatur und das parametrisierte überwachte Signal aus Videoanteilen des Segments und des überwachten Signals abgeleitet werden.

4. Verfahren nach Anspruch 1 oder 2, wobei die Signatur und das parametrisierte überwachte Signal von sowohl Audioals auch Videoteilen des Segmentes und des überwachten Signals abgeleitet werden.

5. Verfahren nach Anspruch 3, wobei die Signatur und das parametrisierte überwachte Signal aus Lumineszenzwerten des Videoanteils abgeleitet werden.

6. Verfahren nach Anspruch 5, wobei die Signatur und das parametrisierte überwachte Signal durch Vergleich von Mittelwertlumineszenzen ausgewählter Bereiche (1_1 bis 1_{16}) eines Bildes (10) des Segmentes bzw. des überwachten Signals mit einer gemittelten Lumineszenz von zumindest einem Bezugsbereich abgeleitet werden, wobei jeder der ausgewähl- ten Bereiche (1_1 bis 1_{16}) ein Bit einer entsprechenden der Signaturen und des paramentrisierten überwachten Signals liefert.

7. Verfahren nach Anspruch 6, wobei die ausgewählten Bereiche (1_1 bis 1_{16}) asymmetrisch von der Mitte des Bildes (10) beabstandet sind.

8. Verfahren nach einem der Ansprüche 6 oder 7, wobei der zumindest eine Bezugsbereich das gesamte Bild (10) ist.

9. Verfahen nach einem der Ansprüche 6 oder 7, wobei der zumindest eine Bezugsbereich für jeden der ausgewählten Bereiche (1_1 bis 1_{16}) ein unterschiedlicher vorausgewählter Bereich des Bildes (10) ist.

10. Verfahren nach einem der Ansprüche 6 oder 7, wobei der zumindest eine Bezugsbereich für jeden der ausgewählten Bereiche (1_1 bis 1_{16}) der entsprechende Bereich eines vorhergehenden Bildes ist.

11. Verfahren nach einem der Ansprüche 6 oder 7, wobei der zumindest eine Bezugsbereich für jeden der ausgewählten Bereiche (1_1 bis 1_{16}) ein unterschiedlicher vorausgewählter Bereich ($1'_1$ bis $1'_{16}$) eines vorhergehenden Bildes (10) ist.

12. Verfahren nach Anspruch 4, wobei die Signatur und das parametrisierte überwachte Signal zumindest teilweise aus einen Frequenzspektrum des Audioanteils abgeleitet werden.

13. Verfahren nach Anspruch 12, wobei die Signatur und das parametrisierte überwachte Signal jeweils einer Anzahl von Digitalwörtern aufweisen, wobei jedes Digitalwort der Signatur und des parametrisierten überwachten Signals durch Vergleich ausgewählter Frequenzbänder des Audioanteils mit zumindest einem Bezugsband abgeleitet werden, wobei jedes der ausgewählten Bänder ein Bit des Digitalwortes liefert.

14. Verfahren nach einem der vorstehenden Ansprüche mit ferner der Reduktion des Datenanteils, an dem der Suchschritt durchgeführt wird, durch Auswahl von weniger als allen Daten der gespeicherten Signaturen, die zu durchsuchen sind.

15. Verfahren nach Anspruch 14, wobei der Datenreduktionsschritt die Zuordnung eines Digitalwortes umfaßt, das ein gewünschtes Bild des Segments mit der Signatur des Segments angibt, wobei die Zuordnung nichtexklusiv ist, der Schritt des digitalen Parametrisierens des überwachten Signals die Ausbildung einer Anzahl von Digitalwörtern umfaßt, die jeweils ein Bild des überwachten Signals angeben, und wobei der Suchschritt für jedes Digitalwort in dem parametrisierten überwachten Signal das Durchsuchen der Bibliothek nach allen gespeicherten Signaturen umfaßt, für die das Digitalwort in dem parametrisierten überwachten Signal mit dem Digitalwort, das das bezeichnete Bild angibt, übereinstimmt.

16. Verfahren nach einem der vorstehenden Ansprüche, wobei jedes der Segmente einen Konstantanteil und einen variablen Anteil aufweist und wobei die Signatur aus einer bekannten Probe des Konstantanteils eines solchen zu erkennenden Segments aufgebaut ist, wobei das Verfahren ferner aufweist:

Aufzeichnen von zusätzlichen Daten aus bekannten Proben des variablen Anteils,

Speichern der zusätzlichen Daten mit der Signatur,

Zuordnen einer Anzeige der Anwesenheit des variablen Anteils zu der gespeicherten Si-

gnatur,

Verwenden der zusätzlichen Daten zur Identifizierung des variablen Anteils eines Sendesegments, sobald der Konstantanteil identifiziert wurde.

17. Verfahren nach Anspruch 16, wobei:

der Schritt des Aufzeichnens der zusätzlichen Daten den Aufbau einer zweiten Signatur für den variablen Anteil umfaßt und

der Verwendungsschritt die Identifizierung des variablen Anteils des Sendesegments mit der zweiten Signatur umfaßt.

18. Verfahren nach Anspruch 16, wobei:

der Schritt des Aufzeichnens der zusätzlichen Daten das Aufzeichnen von zumindest einem Videobild des variablen Anteils umfaßt

und der Verwendungsschritt die Durchführung eines Direktvergleiches des zumindest einen Videobildes und zumindest eines Bildes des überwachten ausgesandten Signals aufweist.

19. Einrichtung zur kontinuierlichen Mustererkennung von Sendersegmenten, wobei die Einrichtung aufweist:

eine Einrichtung zum Aufbau einer digitalen Signatur aus einer bekannten Probe des zu erkennenden Segmentes durch digitales Parametrisieren des Segmentes, Auswahl von Teilen (1_1 bis 1_{16}) aus statistischen Bildpositionen im ganzen parametrisierten Segment in Übereinstimmung mit einem Satz vordefinierter Regeln zur Bildung der Signatur und Zuordnen der Signatur die Bildpositionen der Teile relativ zu einer Bezugsposition,

einer Einrichtung zum Speichern einer Bibliothek von Signaturen und zugeordneten Bildpositionsinformationen, wobei jede Signatur in der Bibliothek mit einem speziellen zu erkennenden Segment identifiziert ist,

einer Einrichtung zur Überwachung eines Sendesignals,

einer Einrichtung zum digitalen Parametrisieren des überwachten Signals auf bildweiser Basis

und einer Einrichtung zum Durchsuchen der Bibliothek nach einer Signatur, die potentiell jedem Bild (10) des parametrisierten überwachten Signal zugeordnet ist, und, unter Verwendung der Bildpositionsinformation, die der potentiell zugeordneten Signatur zugeordnet ist, zum Vergleich der potentiell zugeordneten Signatur mit den geeigneten Bildern (10) des parametrisierten überwachten Signals (20).

20. Einrichtung nach Anspruch 19, wobei:

die Aufbaueinrichtung zum digitalen Parametrisieren des Segmentes durch Ausbildung einer Folge von Digitalwörtern arbeitet, wobei jedes der Digitalwörter ein Bild (10) des Segmentes repräsentiert, wobei die Aufbaueinrichtung ferner arbeitet, um ein Wort, das ein bezeichnetes Bild (10) in dem Segment repräsentiert, zu identifizieren, wobei die Zuordnung zum Segment des Wortes, das das bezeichnete Bild (10) repräsentiert, nichtexklusiv ist, und um eine Anzahl von zusätzlichen Wörtern auswählen, von denen jedes jeweils eines der Bilder (10) bei den statistischen Bildpositionen repräsentiert,

wobei die Speichereinrichtung arbeitet, um in der Signaturbibliothek die Digitalwörter zu speichern, die das ausgezeichnete Bild (10) und die zusätzlichen Bilder (10) repräsentieren, zusammen mit Offsets der zusätzlichen Bilder relativ zum bezeichneten Bild,

wobei die Einrichtung zum digitalen Parametrisieren des überwachten Signal arbeitet, um eine Folge von überwachten Digitalwörtern zu bilden, von denen jedes ein Bild (10) davon angibt, und

wobei die Sucheinrichtung arbeitet, um die Bibliothek nach einer Signatur zu durchsuchen, für die ein überwachtes Digitalwort das bezeichnete Bild (10) repräsentiert und um die zusätzlichen Wörter jeder solchen Signatur mit den Wörtern des parametrisierten überwachten Signals bei den Offsets relativ zum überwachten Digitalwort zu vergleichen.

21. Einrichtung nach einem der Ansprüche 19 oder 20, wobei die Aufbaueinrichtung an einem Videoanteil des Segmentes arbeitet.

22. Einrichtung nach einem der Ansprüche 19 oder 20, wobei die Aufbaueinrichtung sowohl an einem Audioanteil als auch an einem Videoanteil des Sements arbeitet.

23. Einrichtung nach einem der Ansprüche 19 bis 22, wobei jedes der Segmente einen Konstantanteil und einen variablen Anteil aufweist und wobei jede Signatur aus einer bekannten Probe des Konstantanteils eines solchen zu erkennenden Segments aufgebaut ist, wobei die Einrichtung ferner aufweist:

eine Einrichtung (82, 83) zum Aufzeichnen von zusätzlichen Daten bekannter Proben des variablen Anteils, eine Einrichtung (81) zum Speichern der zusätzlichen Daten mit der Signatur,

eine Einrichtung (26) zur Zuordnung einer Anzeige der Anwesenheit des variablen Anteils der gespeicherten Signatur,

und eine Einrichtung (82) zur Verwendung der zusätzlichen Daten zur Identifizierung des variablen Anteils eines ausgesandten Sendeseg-

mentes, sobald der Konstantanteil identifiziert wurde.

24. Einrichtung nach Anspruch 23, wobei:
die Aufzeichnungseinrichtung eine Einrichtung (82) zum Aufbau einer zweiten Signatur für den variablen Anteil ausweist und
die Verwendungseinrichtung (82) eine Einrichtung zur Identifizierung eines varibalen Anteils des Sendesegments mit der zweiten Signatur aufweist.

25. Einrichtung nach Anspruch 23, wobei:
die Aufzeichnungseinrichtung eine Einrichtung (83) zum Aufzeichnen von zumindest einem Videobild des variablen Anteils aufweist und
die Verwendungseinrichtung eine Einrichtung aufweist zur Durchführung eines Direktvergleichs des zumindest einen Videobildes und zumindest eines Bildes des überwachten ausgesandten Signals aufweist.

26. Einrichtung nach einem der Ansprüche 19 bis 25 mit ferner:
einer Einrichtung zur Erfassung des Auftretens von Artefakten eines potentiell unbekannten zu erkennenden Segmentes und
einer Einrichtung zur Klassifizierung und Identifizierung der potentiell unbekannten Segmente.

27. System zur kontinuierlichen Mustererkennung eines Sendesegments mit einer Einrichtung nach Anspruch 26 und mit:
einem Kommunikationsnetzwerk (23a, 23b, 29), das einen Zentralort (22) und eine Anzahl von Lokalorten (21), die in unterschiedlichen geographischen Regionen angeordnet sind, zur Überwachung vom Sendersignalen in den Regionen verbindet,
wobei jeder der lokalen Orte (21) zumindest die Speichereinrichtung aufweist, die Einrichtung zum digitalen Parametrisiern, die Sucheinrichtung und die Erfassungseinrichtung, wobei die Speichereinrichtung eine Lokalbibliothek von Segmentsignaturen aufweist, die für Sendersignale in ihrer geographischen Region verwendbar sind,
wobei der Zentralort (22) die Aufbaueinrichtung und die Speichereinrichtung aufweist, die eine globale Biblio- thek aufweist, die alle Informationen in allen Lokalbibliotheken umfaßt, und wobei die Klassifizierung- und Identifizierungseinrichtung aufweist:
eine Einrichtung, an jedem der lokalen Orte (21), zur Erzeugung von komprimierten Audio und Videoinformationen, einer temporäre Digitalsignatur und parametrisierter überwachter Signalinformationen für ein potentiell unbekanntes Segment, das nicht in der entsprechenen Lokalbibliothek aufgefunden wurde, und zur Übermittlung zumindest der parametrierten, überwachten Signalinformation und der temporären Digitalsignatur für ein potentiell unbekanntes Segment über das Kommunikationsnetzwerk an den Zentralort (22),
eine Einrichtung (22) am Zentralort zum Suchen und Vergleichen von Signaturen, die in der Globalbibilothek gespeichert sind, mit der übertragenen parametrisieren überwachten Signalinformation,
eine Einrichtung (25) am Zentralort (22) zum Zusammengruppieren gleicher potentiell unbekannter Segmente, die durch die Zentralorte (22) von den Lokalorten (21) erhalten wurden und nicht in der globalen Bibiliothek gefunden wurden,
eine Einrichtung (27) am Zentralort (22) zur Anforderung von zumindest einer der komprimierten Audio- und Videoinformationen für zumindest eines der gruppierten potentiell unbekannten Segmente, so daß eine Bedienungsperson die zumindest eine der Audio- und Videoinformationen wiederzugeben kann, zur Klassifizierung des Segmentes und zum Befehlen der Aufbaueinrichtung (25) zum automatischen Aufbau einer Signatur für das Segment, und
eine Einrichtung zum Zufügen der Signatur, die durch die Aufbaueinrichtung am Zentralort (22) aufgebaut wurde, zur Globalbibliothek und zur Übertragung über das Kommunikationsnetzwerk (23a, 23b, 29) an die Lokalbibliotheken.

28. System nach Anspruch 27, wobei die Gruppierungseinrichtung aufweist:
eine Einrichtung (25) zum Vergleich der temporären Digitalsignaturen von anderen potentiell unbekannten Segmenten mit einem parametrisierten, potentiell unbekannten Segment,
eine Einrichtung für alle potentiell unbekannte Segmente, die einer gegebenen temporären Digitalsignatur entsprechen zum temporären Ausrichten der parametrisierten, überwachten Signalinformtion des Segmentes, und
eine Einrichtung zum Aufbau einer besten Anpassung an die ausgerichtete parametrisierte überwachte Signalinformation.

29. System nach einem der Ansprüche 27 oder 28 mit ferner einer Einrichtung zur Übertragung von Informationen betreffend das Auftreten von Sendersegmenten von jedem der lokalen Orte (21) an den Zentralort (22) und einer Einrichtung am Zentralort (22) zum Speichern der Informationen.

30. System nach Anspruch 29, mit ferner einer Einrichtung an dem Lokalort (21) zum Speichern der temporären Digitalsignatur eines potentiell unbekannten Segmentes und zum Speichern des Auftretens des potentiell unbekannten Segmentes aufgrund der gespeicherten Temporärsignatur als Speicherinformation, und eine Einrichtung zum Übertragen der Speicherinformtion an den Zentralort (22) nachdem der Zentralort (22) das potentiell unbekannte Segment identifiziert hat.

Revendications

1. Procédé pour la reconnaissance continue de modèles de segments télédiffusés, ledit procédé comportant :

la construction d'une signature numérique à partir d'un échantillon connu d'un segment devant être reconnu par paramétrage numérique dudit segment, la sélection de parties (1_1 à 1_{16}) parmi des emplacements de trame aléatoires dans ledit segment paramétré en fonction d'un ensemble de règles prédéfinies de façon à former ladite signature, et l'association à ladite signature des emplacements de trame desdites parties par rapport à un emplacement de référence;

le stockage de ladite signature et de l'information d'emplacement de trame associée dans une bibliothèque de signatures, chaque signature dans ladite bibliothèque étant identifiée à un segment particulier devant être reconnu;

le contrôle d'un signal télédiffusé;

le paramétrage numérique dudit signal contrôlé sur une base trame par trame;

pour chaque trame (10) dudit signal contrôlé paramétré, la recherche de ladite bibliothèque pour une signature potentiellement associée et, en utilisant l'information d'emplacement de trame associée à ladite signature potentiellement associée, la comparaison de ladite signature potentiellement associée à des trames (10) appropriées dudit signal contrôlé paramétré.

2. Procédé selon la revendication 1, selon lequel :

l'étape de construction d'une signature numérique à partir d'un échantillon connu d'un segment devant être reconnu comprend le paramétrage numérique dudit segment en formant une chaîne de mots numériques représentant chacun une trame dudit segment, l'identification d'un mot représentant une trame désignée dans ledit segment, l'association avec ledit segment du mot représentant ladite trame désignée n'étant pas exclusive, l'identification des décalages desdits emplacements de trame par rapport à ladite trame désignée, et la sélection de plusieurs mots additionnels représentant chacun une trame respective des trames au niveau desdits emplacements de trame;

l'étape de stockage de ladite signature et de l'information d'emplacement de trame comprend le stockage du mot représentant ladite trame désignée et de ladite multiplicité de mots additionnels avec l'information représentant les décalages desdits emplacements de trame par rapport à ladite trame désignée;

l'étape de paramétrage numérique dudit signal contrôlé comporte la formation d'une pluralité de mots numériques contrôlés représentant chacun une trame dudit signal contrôlé; et

pour chaque trame dudit signal contrôlé paramétré, l'étape de recherche de ladite bibliothèque comprend la recherche de ladite bibliothèque pour une signature quelconque pour laquelle le mot numérique contrôlé représentant ladite trame représente également ladite trame désignée, et la comparaison des mots additionnels d'une signature quelconque avec les mots dudit signal contrôlé paramétré pour lesdits décalages par rapport audit mot numérique contrôlé.

3. Procédé selon la revendication 1 ou 2, selon lequel ladite signature et le signal contrôlé paramétré sont obtenus à partir de parties vidéo dudit segment et dudit signal contrôlé.

4. Procédé selon la revendication 1 ou 2, selon lequel ladite signature et le signal contrôlé paramétré sont obtenus à partir à la fois de parties audio et vidéo dudit segment et dudit signal contrôlé.

5. Procédé selon la revendication 3, selon lequel ladite signature et ledit signal contrôlé paramétré sont obtenus à partir des valeurs de luminance de ladite partie vidéo.

6. Procédé selon la revendication 5, selon lequel ladite signature et ledit signal contrôlé paramétré sont obtenus en comparant des luminances moyennes de zones choisies (1_1 à 1_{16}) d'une trame (10) dudit segment et du signal contrôlé respectivement à une luminance moyenne d'au moins une zone de référence, chacune desdites zones choisies (1_1 à 1_{16}) procurant un bit de ladite signature ou dudit signal contrôlé paramétré respectif.

7. Procédé selon la revendication 6, selon lequel lesdites zones choisies (1_1 à 1_{16}) sont espacées de manière asymétrique autour du centre de ladite trame (10).

8. Procédé selon la revendication 6 ou 7, selon le-

quel au moins ladite zone de référence est ladite trame (10) complète.

9. Procédé selon la revendication 6 ou 7, selon lequel au moins ladite zone de référence est, pour chacune desdites zones choisies (1_1 à 1_{16}), une zone prédéterminée différente de ladite trame (10).

10. Procédé selon la revendication 6 ou 7, selon lequel au moins ladite zone de référence est, pour chacune desdites zones choisies (1_1 à 1_{16}), la zone correspondante d'une trame précédente.

11. Procédé selon la revendication 6 ou 7, selon lequel au moins ladite zone de référence est, pour chacune desdites zones choisies (1_1 à 1_{16}), une zone prédéterminée différente ($1'_1$ à $1'_{16}$) d'une trame (10) précédente.

12. Procédé selon la revendication 4, selon lequel ladite signature et ledit signal contrôlé paramétré sont obtenus au moins en partie à partir d'un spectre de fréquence de ladite partie audio.

13. Procédé selon la revendication 12, selon lequel ladite signature et ledit signal contrôlé paramétré comportent chacun plusieurs mots numériques, chaque mot numérique de ladite signature et dudit signal contrôlé paramétré étant obtenu en comparant des bandes de fréquences choisies de ladite partie audio à au moins une bande de référence, chacune desdites bandes choisies procurant un bit dudit mot numérique.

14. Procédé selon l'une quelconque des revendications précédentes, comportant, en outre, la réduction de la quantité de données sur lesquelles ladite étape de recherche est réalisée en choisissant moins de la totalité des données des signatures stockées devant être recherchées.

15. Procédé selon la revendication 14, selon lequel ladite étape de réduction de données comporte l'association d'un mot numérique représentant une trame désignée dudit segment et de la signature dudit segment, ladite association n'étant pas exclusive, l'étape de paramétrage numérique dudit signal contrôlé comporte la formation de plusieurs mots numériques représentant chacun une trame dudit signal contrôlé, et ladite étape de recherche comporte, pour chaque mot numérique dans ledit signal contrôlé paramétré, la recherche de ladite bibliothèque pour une signature stockée quelconque pour laquelle ledit mot numérique dans ledit signal contrôlé paramétré correspond audit mot numérique représentant ladite trame désignée.

16. Procédé selon l'une quelconque des revendications précédentes, selon lequel chacun desdits segments comprend une partie constante et une partie variable; et où ladite signature est construite à partir d'un échantillon connu de la partie constante d'un tel segment devant être reconnu; ledit procédé comportant en outre :

l'enregistrement de données additionnelles à partir des échantillons connus de ladite partie variable;

le stockage desdites données additionnelles avec ladite signature;

l'association à ladite signature stockée d'une indication de l'existence de ladite partie variable;

l'utilisation desdites données additionnelles afin d'identifier la partie variable d'un segment télédiffusé une fois que la partie constante a été identifiée.

17. Procédé selon la revendication 16, selon lequel :

ladite étape d'enregistrement de données additionnelles comporte la construction d'une deuxième signature pour ladite partie variable; et

ladite étape d'utilisation comporte l'identification de la partie variable dudit segment télédiffusé avec ladite deuxième signature.

18. Procédé selon la revendication 16, selon lequel :

ladite étape d'enregistrement de données additionnelles comporte l'enregistrement d'au moins une trame vidéo de ladite partie variable; et

ladite étape d'utilisation comporte la réalisation d'une comparaison directe d'au moins ladite trame vidéo et d'au moins une trame dudit signal télédiffusé contrôlé.

19. Appareil pour la reconnaissance continue de modèles de segments télédiffusés, ledit appareil comportant :

des moyens pour la construction d'une signature numérique à partir d'un échantillon connu d'un segment devant être reconnu par paramétrage numérique dudit segment, la sélection de parties (1_1 à 1_{16}) parmi des emplacements de trame aléatoires dans ledit segment paramétré en fonction d'un ensemble de règles prédéfinies de façon à former ladite signature, et l'association à ladite signature des emplacements de trame desdites parties par rapport à un emplacement de référence;

des moyens pour le stockage d'une bibliothèque de signatures et de l'information d'emplacement de trame associée, chaque signature dans ladite bibliothèque étant identifiée à un segment particulier devant être reconnu;

des moyens pour le contrôle d'un signal té-

lédiffusé;

des moyens pour le paramétrage numérique dudit signal contrôlé sur une base trame par trame; et

des moyens pour la recherche de ladite bibliothèque pour une signature potentiellement associée à chaque trame (10) dudit signal contrôlé paramétré et, en utilisant l'information d'emplacement de trame associée à ladite signature potentiellement associée, pour la comparaison de ladite signature potentiellement associée à des trames (10) appropriées dudit signal contrôlé paramétré.

20. Appareil selon la revendication 19, dans lequel :

lesdits moyens de construction sont opérationnels afin de paramétrer de manière numérique ledit segment en formant une chaîne de mots numériques, chacun desdits mots représentant une trame (10) dudit segment, lesdits moyens de construction étant, en outre, opérationnels pour l'identification d'un mot représentant une trame désignée (10) dans ledit segment, l'association avec ledit segment du mot représentant ladite trame désignée (10) n'étant pas exclusive, et la sélection de plusieurs mots additionnels représentant chacun une trame respective des trames (10) au niveau desdits emplacements de trame aléatoires;

lesdits moyens de stockage étant opérationnels afin de stocker dans ladite bibliothèque de signatures les mots numériques représentant ladite trame désignée (10) et lesdites trames additionnelles (10) avec des décalages desdites trames additionnelles par rapport à ladite trame désignée;

lesdits moyens de paramétrage numérique dudit signal contrôlé étant opérationnels afin de former une chaîne de mots numériques contrôlés représentant chacun une trame (10) de celui-ci; et

lesdits moyens de recherche de ladite bibliothèque étant opérationnels afin de rechercher ladite bibliothèque pour une signature pour laquelle un mot numérique contrôlé représente ladite trame désignée (10) et comparer les mots additionnels d'une signature quelconque avec les mots dudit signal contrôlé paramétré pour lesdits décalages par rapport audit mot numérique contrôlé.

21. Appareil selon la revendication 19 ou 20, dans lequel lesdits moyens de construction agissent sur une partie vidéo dudit segment.

22. Appareil selon la revendication 19 ou 20, dans lequel lesdits moyens de construction agissent sur les deux parties audio et vidéo dudit segment.

23. Appareil selon l'une quelconque des revendications 19 à 22, dans lequel chacun desdits segments comprend une partie constante et une partie variable; et où ladite signature est construite à partir d'un échantillon connu de la partie constante d'un tel segment devant être reconnu; ledit appareil comportant en outre :

des moyens (82, 83) pour l'enregistrement de données additionnelles à partir des échantillons connus de ladite partie variable;

des moyens (81) pour le stockage desdites données additionnelles avec ladite signature;

des moyens (26) pour l'association à ladite signature stockée d'une indication de l'existence de ladite partie variable; et

des moyens (82) pour l'utilisation desdites données additionnelles afin d'identifier la partie variable d'un segment télédiffusé une fois que la partie constante a été identifiée.

24. Appareil selon la revendication 23, dans lequel :

lesdits moyens d'enregistrement comportent des moyens (82) pour la construction d'une deuxième signature pour ladite partie variable; et

lesdits moyens d'utilisation comportent des moyens (82) pour l'identification de la partie variable dudit segment télédiffusé avec ladite deuxième signature.

25. Appareil selon la revendication 23, dans lequel :

lesdits moyens d'enregistrement comportent des moyens (83) pour l'enregistrement d'au moins une trame vidéo de ladite partie variable; et

lesdits moyens d'utilisation comportent des moyens destinés à réaliser une comparaison directe d'au moins ladite trame vidéo et d'au moins une trame dudit signal télédiffusé contrôlé.

26. Appareil selon l'une quelconque des revendications 19 à 25, comportant en outre :

des moyens destinés à détecter, dans ledit signal contrôlé, l'apparition d'artefacts caractéristiques de segments inconnus potentiels devant être reconnus; et

des moyens destinés à classer et identifier lesdits segments inconnus potentiels.

27. Système pour la reconnaissance continue de modèles de segments télédiffusés, incorporant l'appareil selon la revendication 26, et comportant :

un réseau de communication (23a, 23b, 29) reliant un site central (22) et plusieurs sites locaux (21) situés dans différentes régions géographiques afin de contrôler des signaux télédiffusés dans lesdites régions;

chacun desdits sites locaux (21) possède au moins lesdits moyens de stockage, lesdits moyens de paramétrage numérique, lesdits moyens de recherche, et lesdits moyens de détection, lesdits moyens de stockage contenant une bibliothèque locale de signatures de segment applicables aux signaux télédiffusés dans sa région géographique;

ledit site central (22) possède lesdits moyens de construction et moyens de stockage contenant une bibliothèque globale contenant toute l'information dans toutes lesdites bibliothèques locales; et

lesdits moyens de classification et d'identification comportent :

des moyens au niveau de chacun des sites locaux (21) destinés à générer de l'information audio et vidéo comprimée, une signature numérique temporaire, et une information de signal contrôlé paramétré pour un segment inconnu potentiel qui ne se trouve pas dans la bibliothèque locale respective et destinés à transmettre jusqu'audit site central (22) et au moyen dudit réseau de communication au moins ladite information de signal contrôlé paramétré et ladite signature numérique temporaire pour un segment inconnu potentiel;

des moyens (25) au niveau dudit site central pour la recherche et la comparaison de signatures stockées dans ladite bibliothèque globale avec ladite information de signal contrôlé paramétré transmise;

des moyens (25) au niveau dudit site central (22) destinés à regrouper des segments inconnus potentiels équivalents reçus par ledit site central (22) en provenance desdits sites locaux (21) et qui ne se trouvent pas dans ladite bibliothèque globale;

des moyens (27) au niveau dudit site central (22) destinés à demander une au moins de ladite information audio ou vidéo comprimée pour au moins un desdits segments inconnus potentiels regroupés et destinés à permettre à un opérateur de relire au moins une de ladite information audio ou vidéo afin de classer ledit segment et demander auxdits moyens de construction (25) de construire automatiquement une signature pour ledit segment; et

des moyens destinés à ajouter ladite signature construite par lesdits moyens de construction au niveau dudit site central (22) dans ladite bibliothèque globale et destinés à la transmettre aux dites bibliothèques locales par l'intermédiaire dudit réseau de communication (23a, 23b, 29).

28. Système selon la revendication 27, dans lequel lesdits moyens de regroupement comportent :

des moyens (25) destinés à comparer les signatures numériques temporaires d'autres segments inconnus potentiels à un segment inconnu potentiel paramétré;

pour tous les segments inconnus potentiels correspondant à une signature numérique temporaire donnée, des moyens destinés à aligner temporairement l'information de signal contrôlé paramétré desdits segments; et

des moyens destinés à construire une concordance de ladite information de signal contrôlé paramétré alignée.

29. Système selon la revendication 27 ou 28, comportant, en outre, des moyens destinés à transmettre de chacun desdits sites locaux (21) vers ledit site central (22) de l'information concernant l'apparition de segments télédiffusés et des moyens au niveau dudit site central (22) destinés à enregistrer ladite information.

30. Système selon la revendication 29, comportant, en outre, des moyens au niveau dudit site local (21) destinés à stocker la signature numérique temporaire d'un segment inconnu potentiel et destinés à enregistrer les apparitions dudit segment inconnu potentiel sur la base de ladite signature temporaire stockée sous forme d'information enregistrée, et des moyens destinés à transmettre ladite information enregistrée vers ledit site central (22) une fois que ledit site central (22) a identifié ledit segment inconnu potentiel.

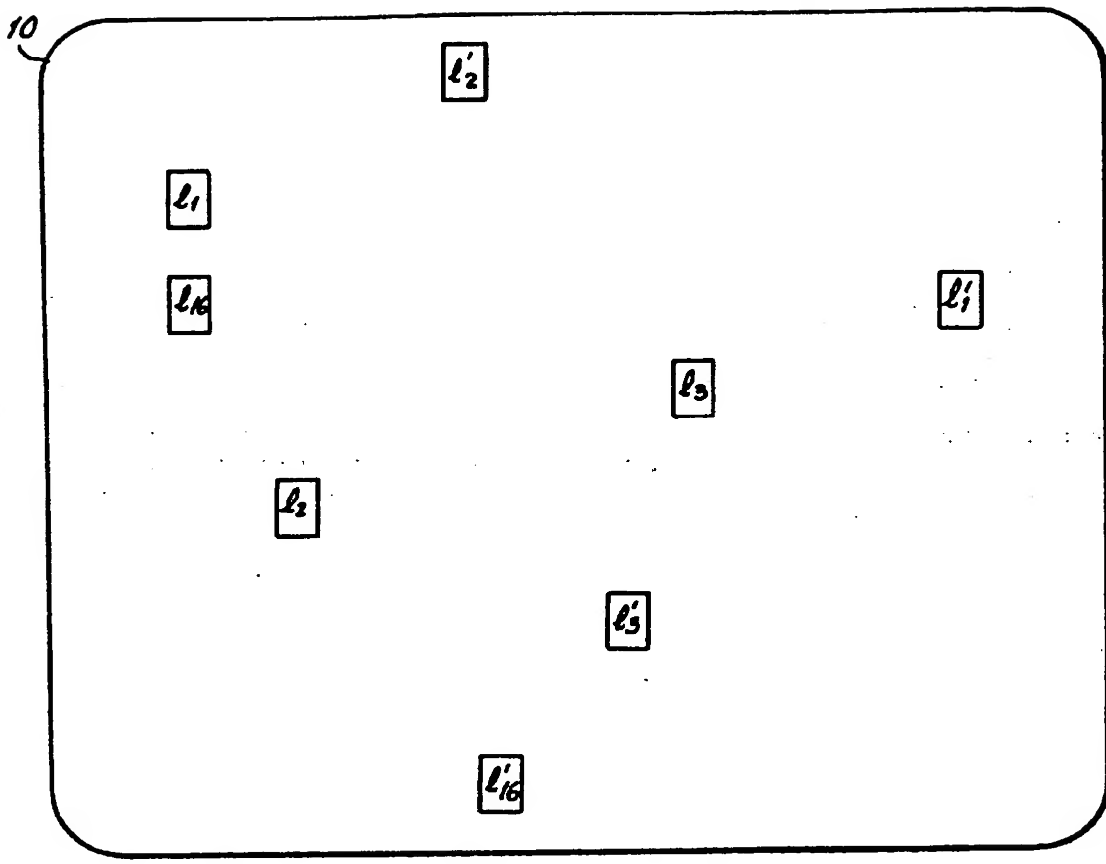


FIG. 1

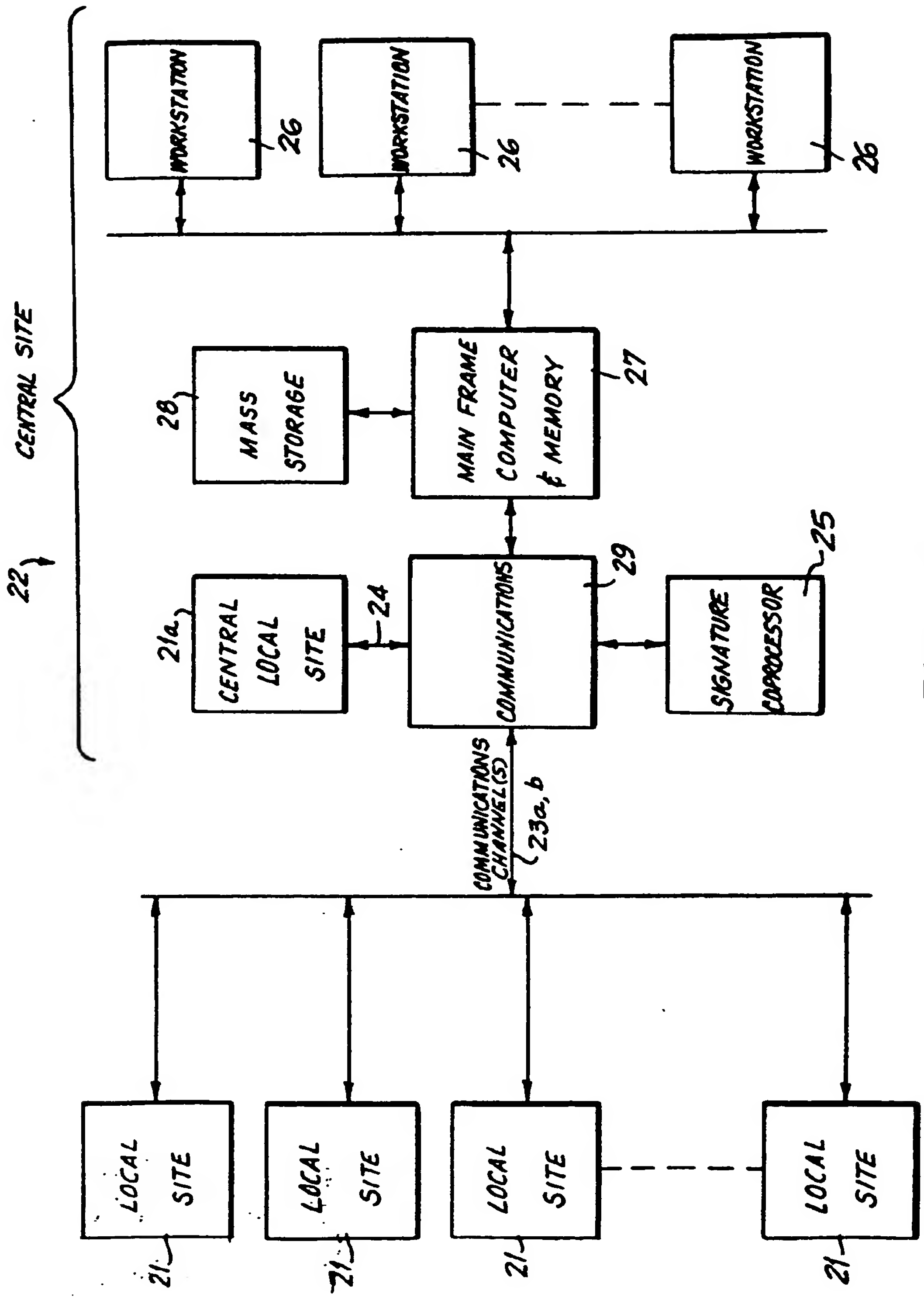

22
CENTRAL SITE
WORKSTATION
26
WORKSTATION
26
WORKSTATION
26
28
MASS STORAGE
MAIN FRAME COMPUTER & MEMORY
27
21a
CENTRAL LOCAL SITE
24
COMMUNICATIONS
29
SIGNATURE COPROCESSOR
25
COMMUNICATIONS CHANNEL(S)
23a, b
LOCAL SITE
21
LOCAL SITE
21
LOCAL SITE
21
LOCAL SITE
21

FIG. 2

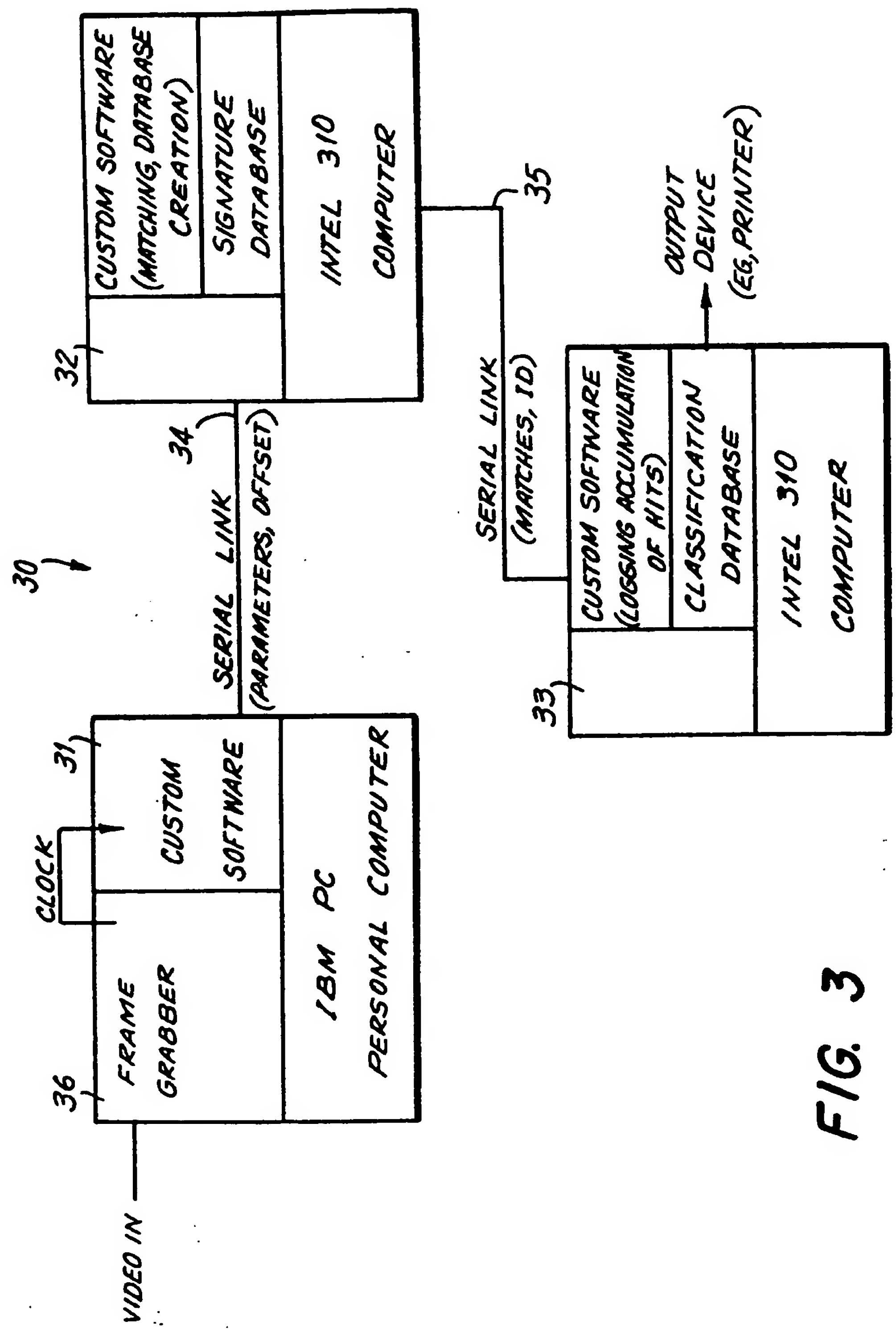
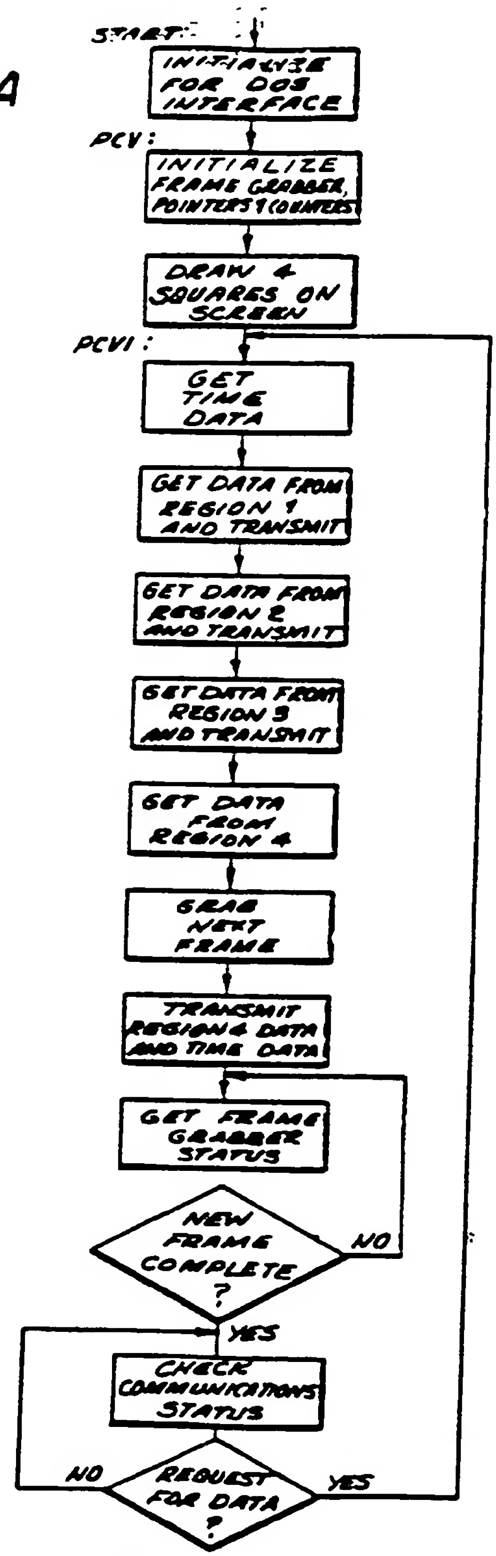

30
31
32
33
34
35
36
VIDEO IN
FRAME GRABBER
CLOCK
CUSTOM SOFTWARE
IBM PC PERSONAL COMPUTER
SERIAL LINK (PARAMETERS, OFFSET)
CUSTOM SOFTWARE (MATCHING, DATABASE CREATION)
SIGNATURE DATABASE
INTEL 310 COMPUTER
SERIAL LINK (MATCHES, ID)
CUSTOM SOFTWARE (LOGGING ACCUMULATION OF HITS)
CLASSIFICATION DATABASE
INTEL 310 COMPUTER
OUTPUT DEVICE (EG, PRINTER)

FIG. 3

FIG. 4A


START
INITIALIZE FOR DOS INTERFACE
PCV:
INITIALIZE FRAME GRABBER, POINTERS & COUNTERS
DRAW 4 SQUARES ON SCREEN
PCVI:
GET TIME DATA
GET DATA FROM REGION 1 AND TRANSMIT
GET DATA FROM REGION 2 AND TRANSMIT
GET DATA FROM REGION 3 AND TRANSMIT
GET DATA FROM REGION 4
GRAB NEXT FRAME
TRANSMIT REGION 4 DATA AND TIME DATA
GET FRAME GRABBER STATUS
NEW FRAME COMPLETE ?
NO
YES
CHECK COMMUNICATIONS STATUS
REQUEST FOR DATA ?
NO
YES

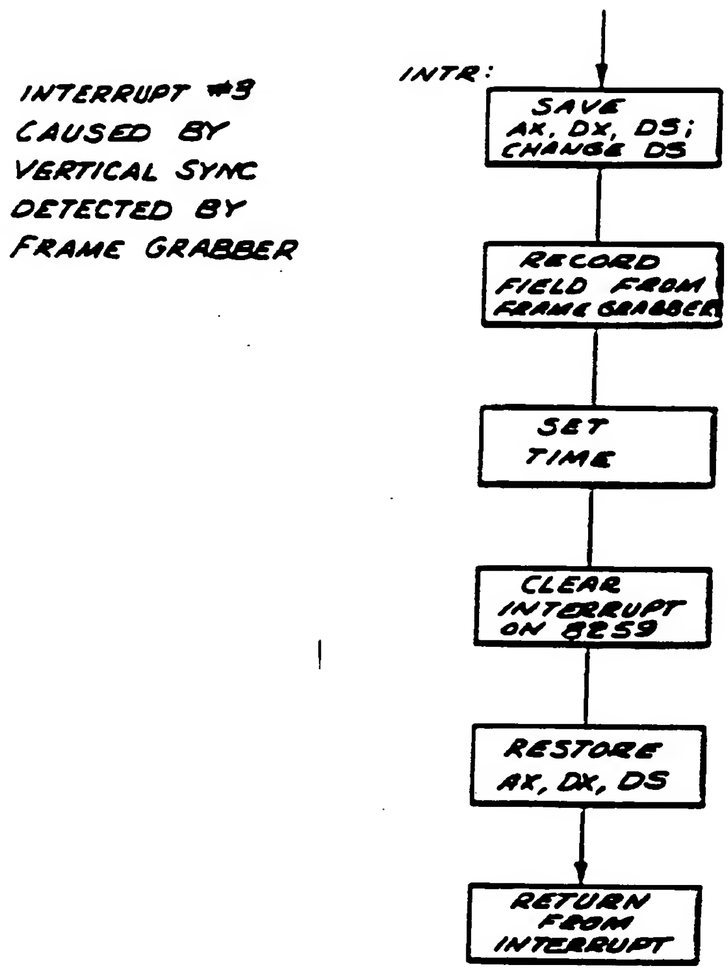

INTERRUPT #3
CAUSED BY
VERTICAL SYNC
DETECTED BY
FRAME GRABBER
INTR:
SAVE
AX, DX, DS;
CHANGE DS
RECORD
FIELD FROM
FRAME GRABBER
SET
TIME
CLEAR
INTERRUPT
ON 8259
RESTORE
AX, DX, DS
RETURN
FROM
INTERRUPT

FIG. 4B

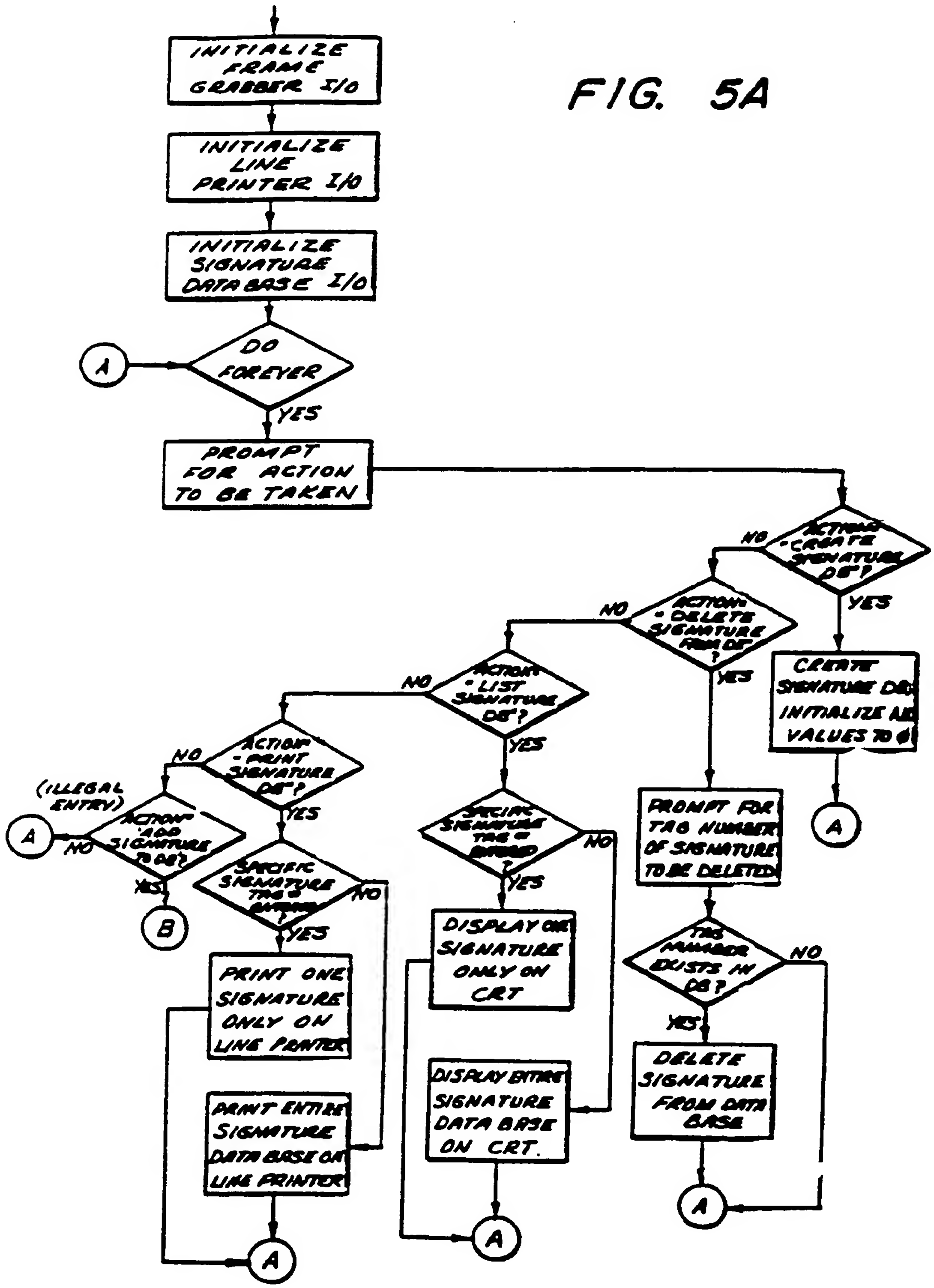

INITIALIZE FRAME GRABBER I/O
INITIALIZE LINE PRINTER I/O
INITIALIZE SIGNATURE DATA BASE I/O
DO FOREVER
YES
PROMPT FOR ACTION TO BE TAKEN
ACTION = CREATE SIGNATURE DB?
YES
NO
CREATE SIGNATURE DB; INITIALIZE ALL VALUES TO Ø
ACTION = DELETE SIGNATURE FROM DB?
PROMPT FOR TAG NUMBER OF SIGNATURE TO BE DELETED
TAG NUMBER EXISTS IN DB?
DELETE SIGNATURE FROM DATA BASE
ACTION = LIST SIGNATURE DB?
SPECIFIC SIGNATURE TAG # ENTERED?
DISPLAY ONE SIGNATURE ONLY ON CRT
DISPLAY ENTIRE SIGNATURE DATA BASE ON CRT.
ACTION = PRINT SIGNATURE DB?
PRINT ONE SIGNATURE ONLY ON LINE PRINTER
PRINT ENTIRE SIGNATURE DATA BASE ON LINE PRINTER
(ILLEGAL ENTRY)
ACTION = ADD SIGNATURE TO DB?
A
B

FIG. 5A

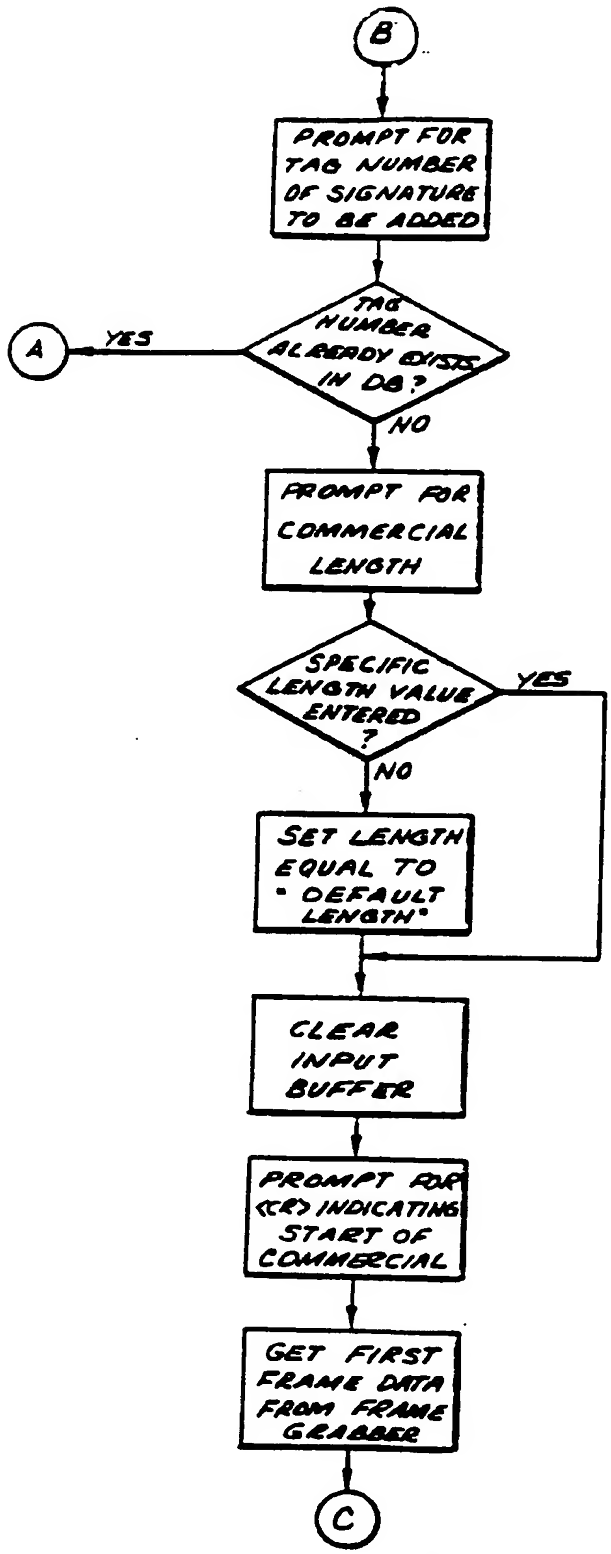

B
PROMPT FOR TAG NUMBER OF SIGNATURE TO BE ADDED
TAG NUMBER ALREADY EXISTS IN DB?
YES
A
NO
PROMPT FOR COMMERCIAL LENGTH
SPECIFIC LENGTH VALUE ENTERED ?
YES
NO
SET LENGTH EQUAL TO "DEFAULT LENGTH"
CLEAR INPUT BUFFER
PROMPT FOR <CR> INDICATING START OF COMMERCIAL
GET FIRST FRAME DATA FROM FRAME GRABBER
C

FIG. 5B

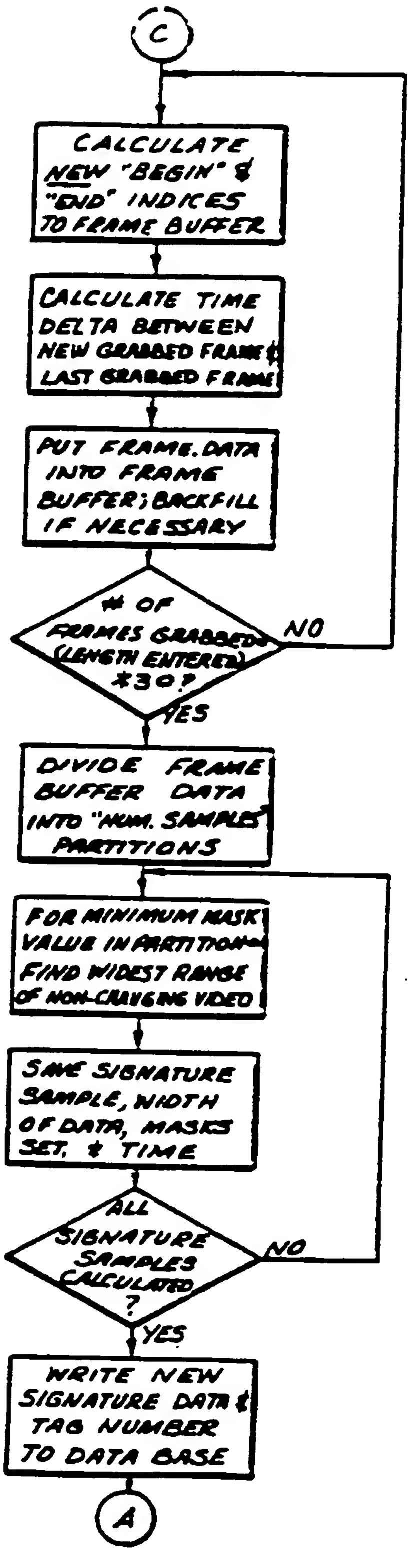

C
CALCULATE NEW "BEGIN" & "END" INDICES TO FRAME BUFFER
CALCULATE TIME DELTA BETWEEN NEW GRABBED FRAME & LAST GRABBED FRAME
PUT FRAME.DATA INTO FRAME BUFFER; BACKFILL IF NECESSARY
OF FRAMES GRABBED = (LENGTH ENTERED) *30?
NO
YES
DIVIDE FRAME BUFFER DATA INTO "NUM. SAMPLES" PARTITIONS
FOR MINIMUM MASK VALUE IN PARTITION FIND WIDEST RANGE OF NON-CHANGING VIDEO
SAVE SIGNATURE SAMPLE, WIDTH OF DATA, MASKS SET, & TIME
ALL SIGNATURE SAMPLES CALCULATED?
NO
YES
WRITE NEW SIGNATURE DATA & TAG NUMBER TO DATA BASE
A

FIG. 5C

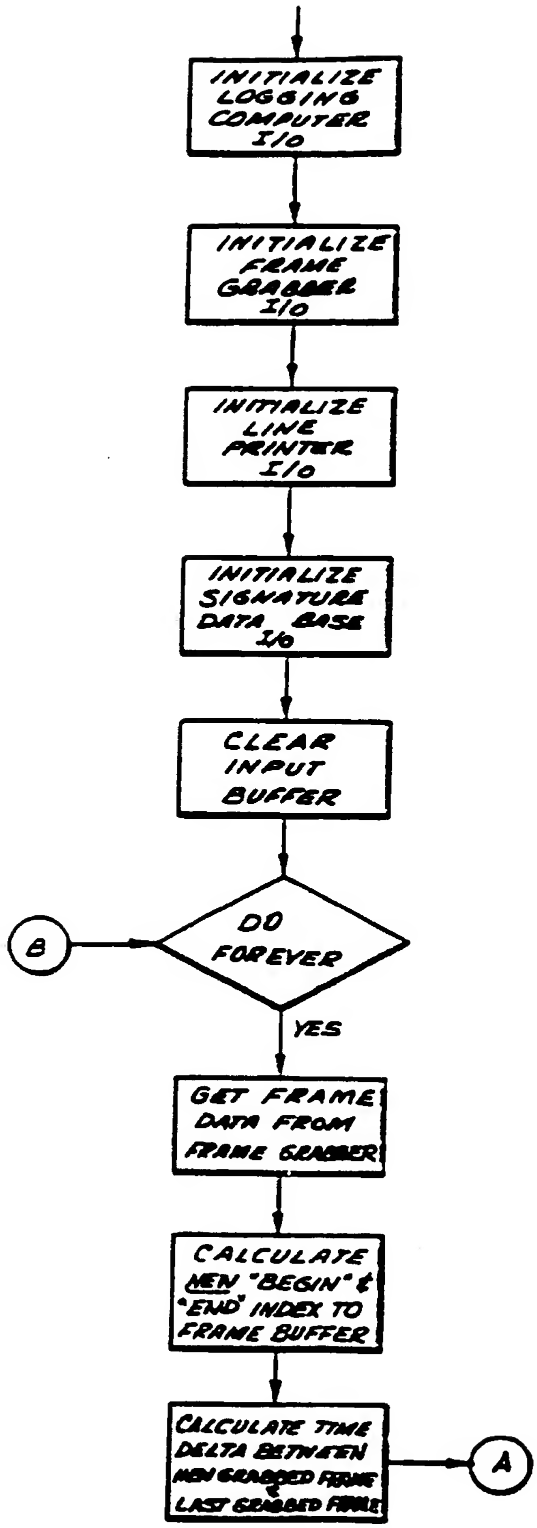
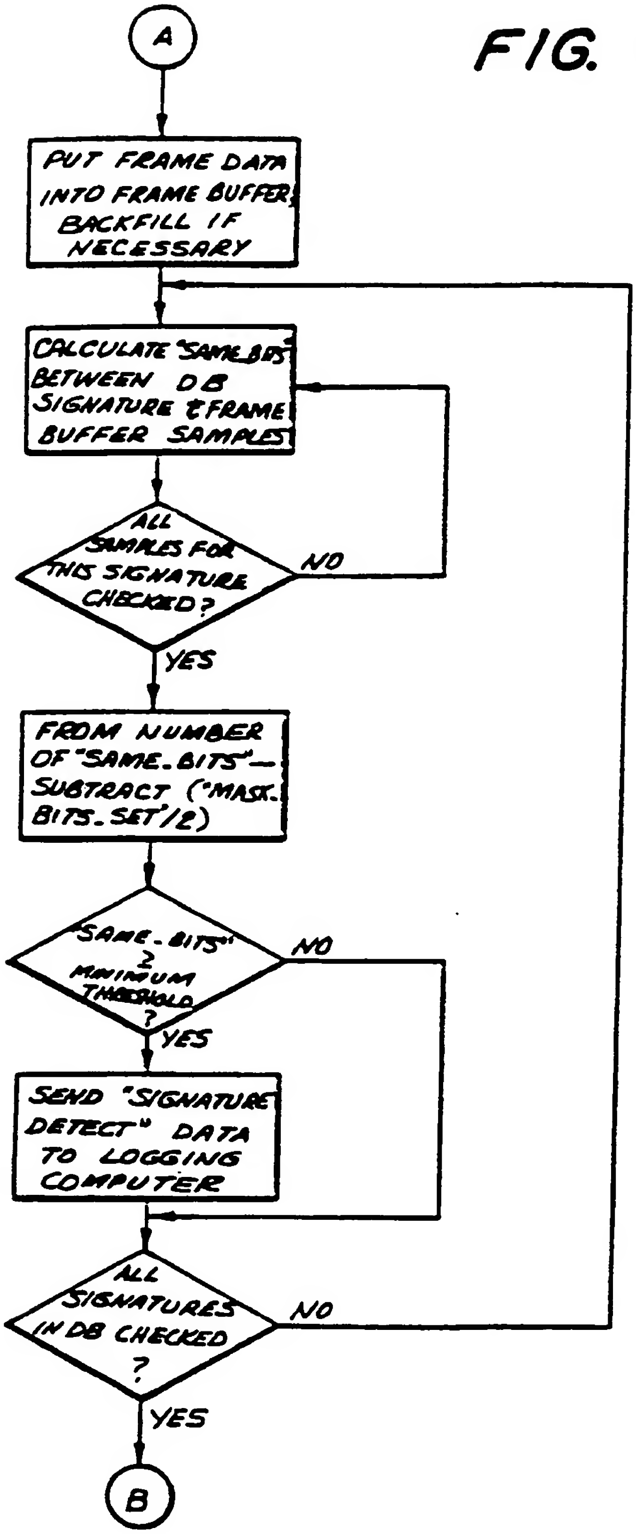

INITIALIZE LOGGING COMPUTER I/O
INITIALIZE FRAME GRABBER I/O
INITIALIZE LINE PRINTER I/O
INITIALIZE SIGNATURE DATA BASE I/O
CLEAR INPUT BUFFER
B
DO FOREVER
YES
GET FRAME DATA FROM FRAME GRABBER
CALCULATE NEW "BEGIN" & "END" INDEX TO FRAME BUFFER
CALCULATE TIME DELTA BETWEEN NEW GRABBED FRAME & LAST GRABBED FRAME
A

FIG. 6A

FIG. 6B


A
PUT FRAME DATA INTO FRAME BUFFER; BACKFILL IF NECESSARY
CALCULATE "SAME.BITS" BETWEEN DB SIGNATURE & FRAME BUFFER SAMPLES
ALL SAMPLES FOR THIS SIGNATURE CHECKED?
NO
YES
FROM NUMBER OF "SAME.BITS"—SUBTRACT ("MASK.BITS.SET"/2)
"SAME.BITS" ≥ MINIMUM THRESHOLD ?
NO
YES
SEND "SIGNATURE DETECT" DATA TO LOGGING COMPUTER
ALL SIGNATURES IN DB CHECKED ?
NO
YES
B

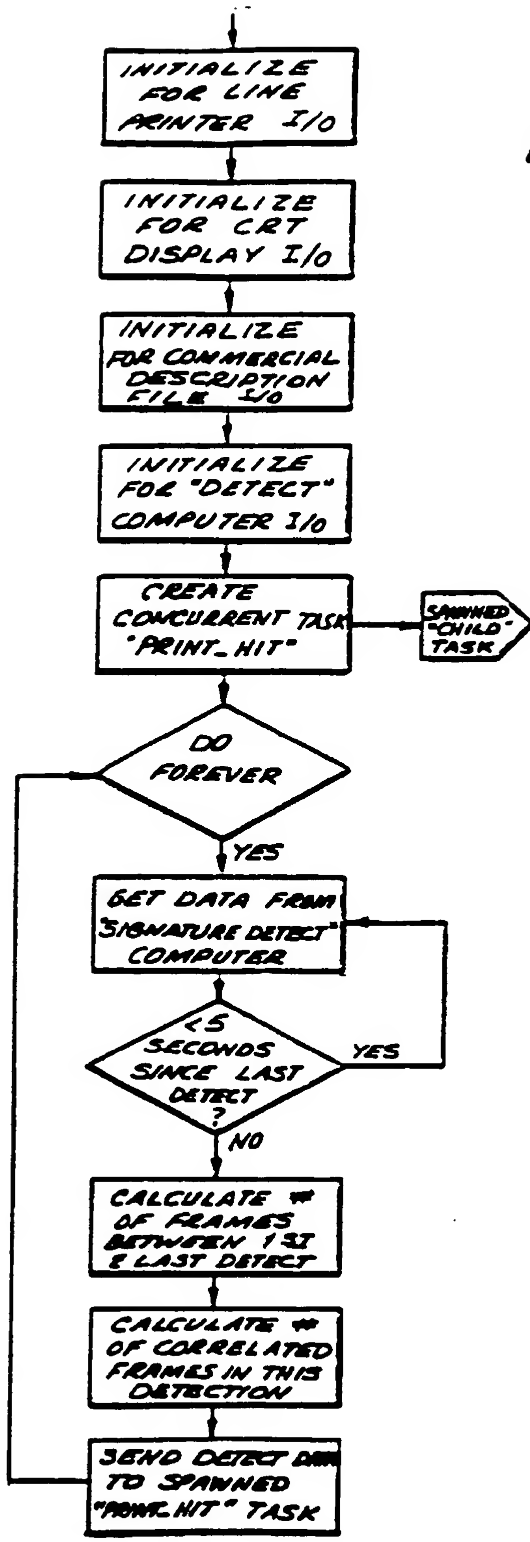

INITIALIZE FOR LINE PRINTER I/O
INITIALIZE FOR CRT DISPLAY I/O
INITIALIZE FOR COMMERCIAL DESCRIPTION FILE I/O
INITIALIZE FOR "DETECT" COMPUTER I/O
CREATE CONCURRENT TASK "PRINT_HIT"
SPAWNED "CHILD" TASK
DO FOREVER
YES
GET DATA FROM "SIGNATURE DETECT" COMPUTER
<5 SECONDS SINCE LAST DETECT ?
YES
NO
CALCULATE # OF FRAMES BETWEEN 1ST & LAST DETECT
CALCULATE # OF CORRELATED FRAMES IN THIS DETECTION
SEND DETECT DATA TO SPAWNED "PRINT_HIT" TASK

FIG. 7A

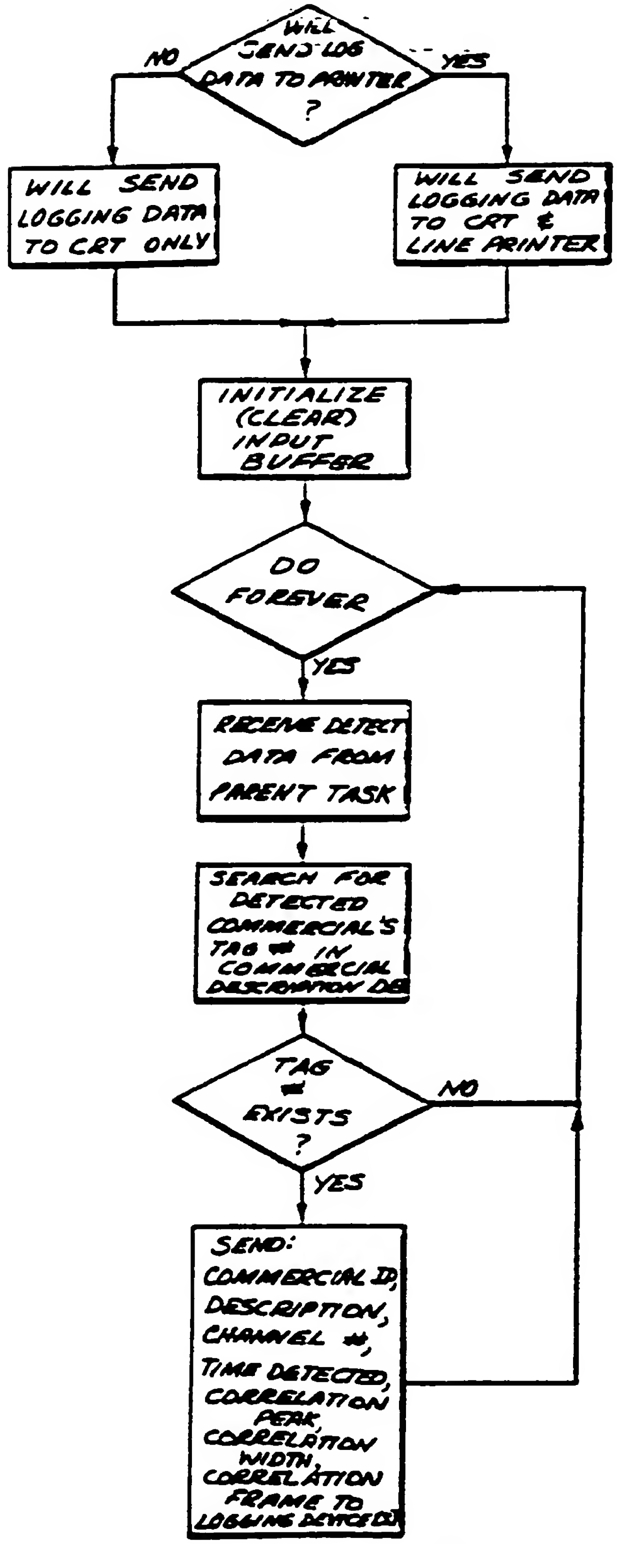

WILL SEND LOG DATA TO PRINTER ?
NO
YES
WILL SEND LOGGING DATA TO CRT ONLY
WILL SEND LOGGING DATA TO CRT & LINE PRINTER
INITIALIZE (CLEAR) INPUT BUFFER
DO FOREVER
YES
RECEIVE DETECT DATA FROM PARENT TASK
SEARCH FOR DETECTED COMMERCIAL'S TAG # IN COMMERCIAL DESCRIPTION DB
TAG # EXISTS ?
NO
YES
SEND: COMMERCIAL ID, DESCRIPTION, CHANNEL #, TIME DETECTED, CORRELATION PEAK, CORRELATION WIDTH, CORRELATION FRAME TO LOGGING DEVICE(S)

FIG. 7B

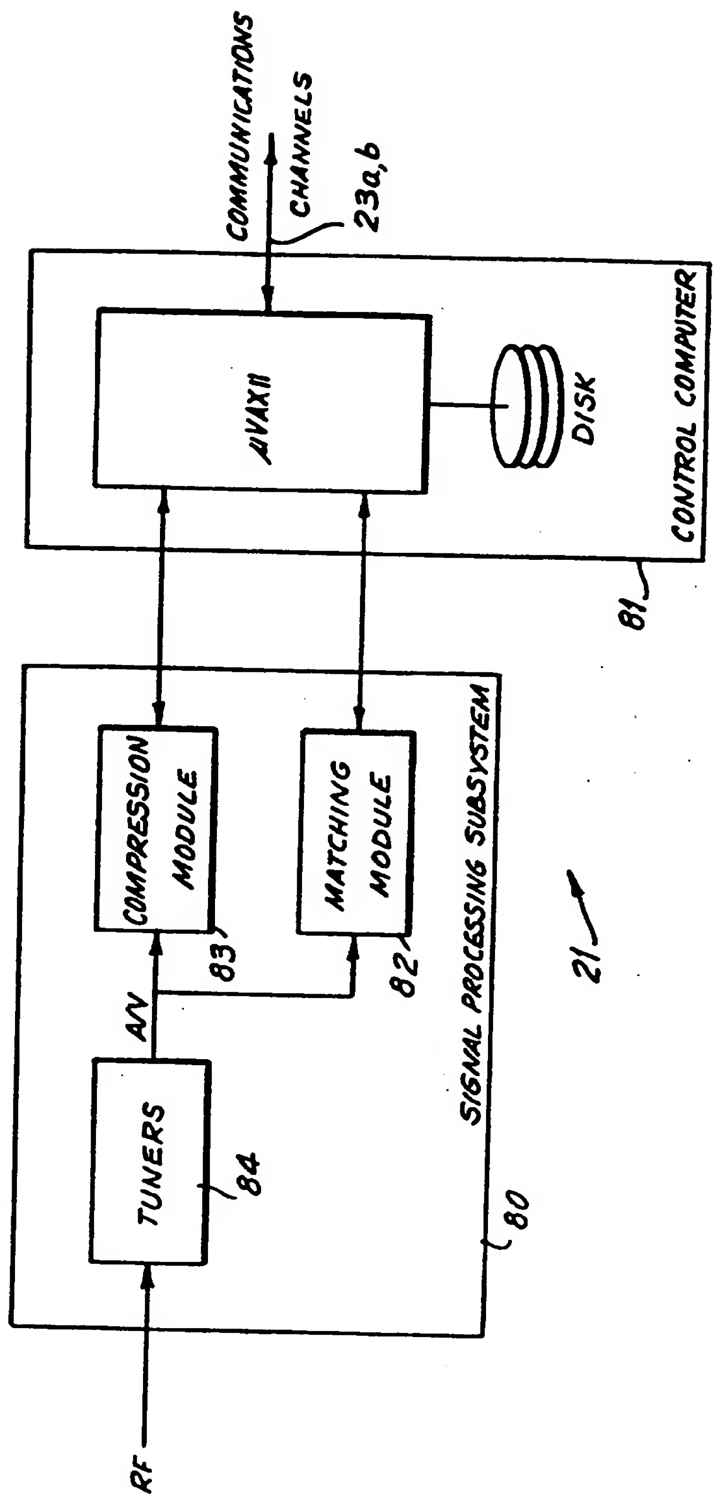

COMMUNICATIONS
CHANNELS
23a,b
μVAX II
DISK
CONTROL COMPUTER
81
COMPRESSION MODULE
83
MATCHING MODULE
82
A/V
TUNERS
84
SIGNAL PROCESSING SUBSYSTEM
80
21
RF

FIG. 8

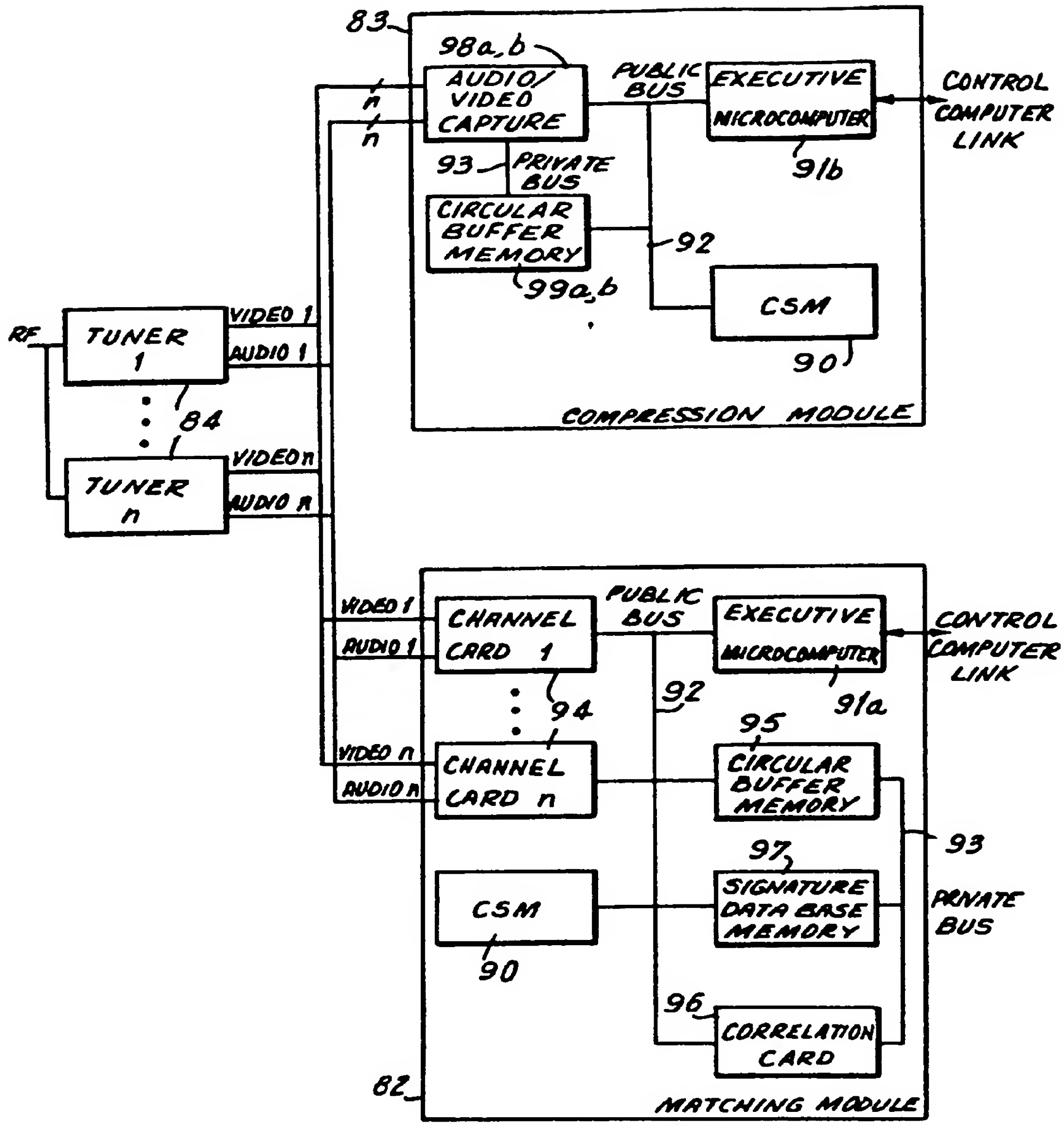

83
98a,b
AUDIO/ VIDEO CAPTURE
PUBLIC BUS
EXECUTIVE MICROCOMPUTER
CONTROL COMPUTER LINK
n
n
93
PRIVATE BUS
91b
CIRCULAR BUFFER MEMORY
92
99a,b
CSM
90
RF
TUNER 1
VIDEO 1
AUDIO 1
84
TUNER n
VIDEO n
AUDIO n
COMPRESSION MODULE
VIDEO 1
AUDIO 1
CHANNEL CARD 1
PUBLIC BUS
EXECUTIVE MICROCOMPUTER
CONTROL COMPUTER LINK
92
91a
94
95
VIDEO n
AUDIO n
CHANNEL CARD n
CIRCULAR BUFFER MEMORY
93
97
SIGNATURE DATA BASE MEMORY
PRIVATE BUS
CSM
90
96
CORRELATION CARD
82
MATCHING MODULE

FIG.9

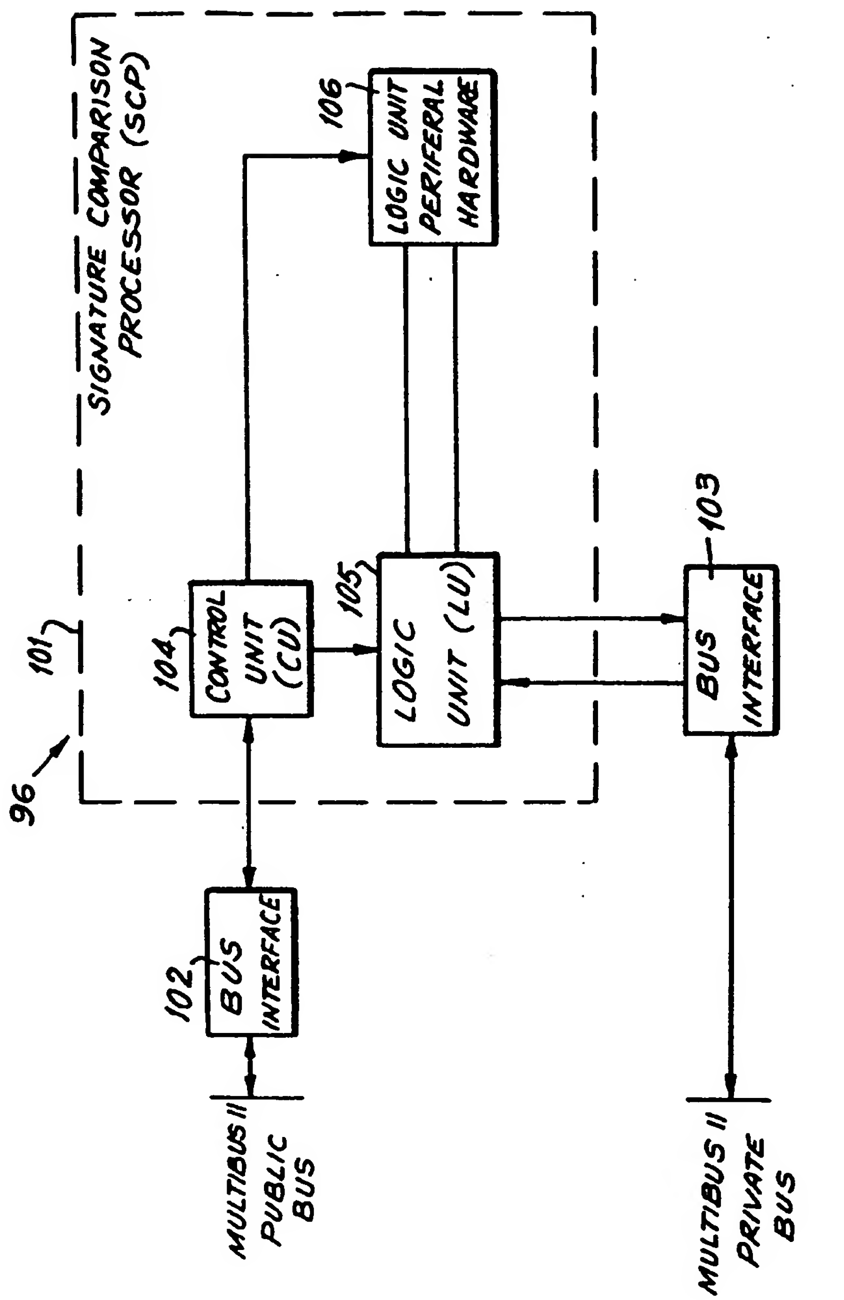

96
101
SIGNATURE COMPARISON PROCESSOR (SCP)
104
CONTROL UNIT (CU)
105
LOGIC UNIT (LU)
106
LOGIC UNIT PERIFERAL HARDWARE
102
BUS INTERFACE
103
BUS INTERFACE
MULTIBUS II PUBLIC BUS
MULTIBUS II PRIVATE BUS

FIG. 10

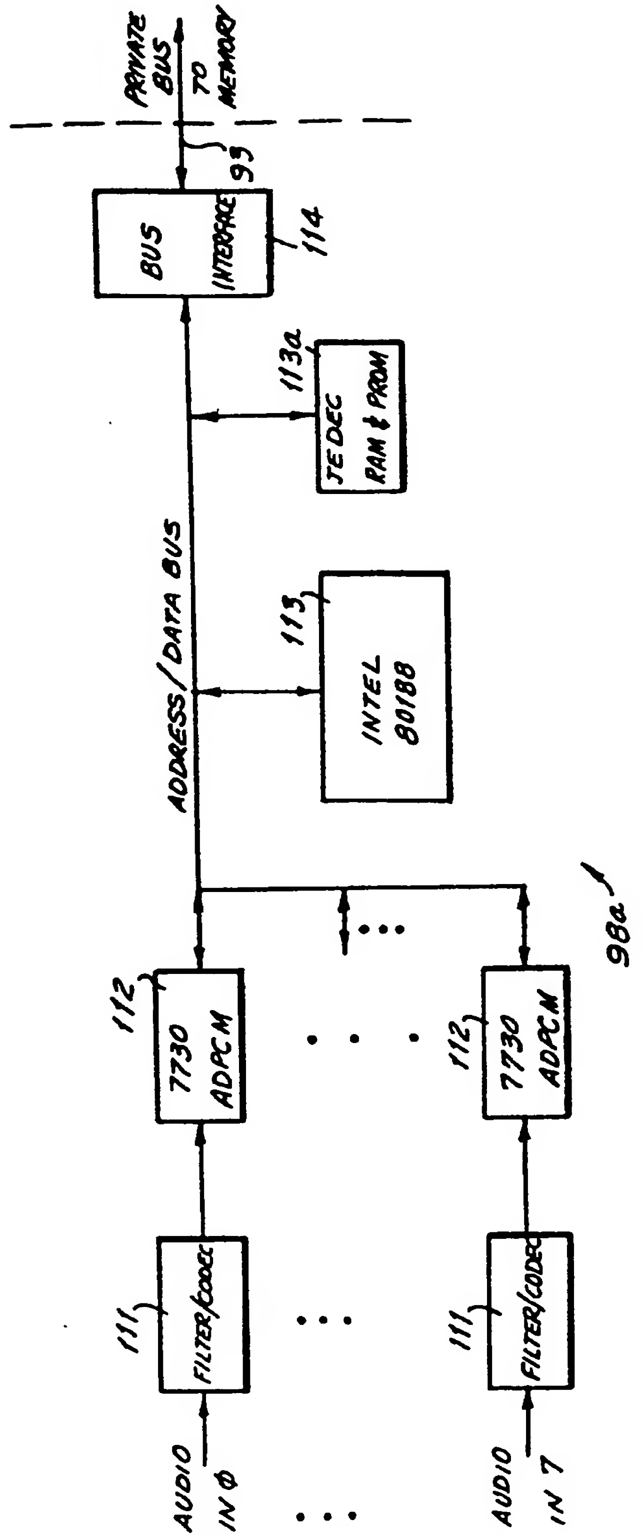

PRIVATE BUS
TO MEMORY
93
BUS INTERFACE
114
113a
JEDEC RAM & PROM
ADDRESS/DATA BUS
113
INTEL 80188
98a
112
7730 ADPCM
111
FILTER/CODEC
AUDIO IN Φ
AUDIO IN 7

FIG. 11A

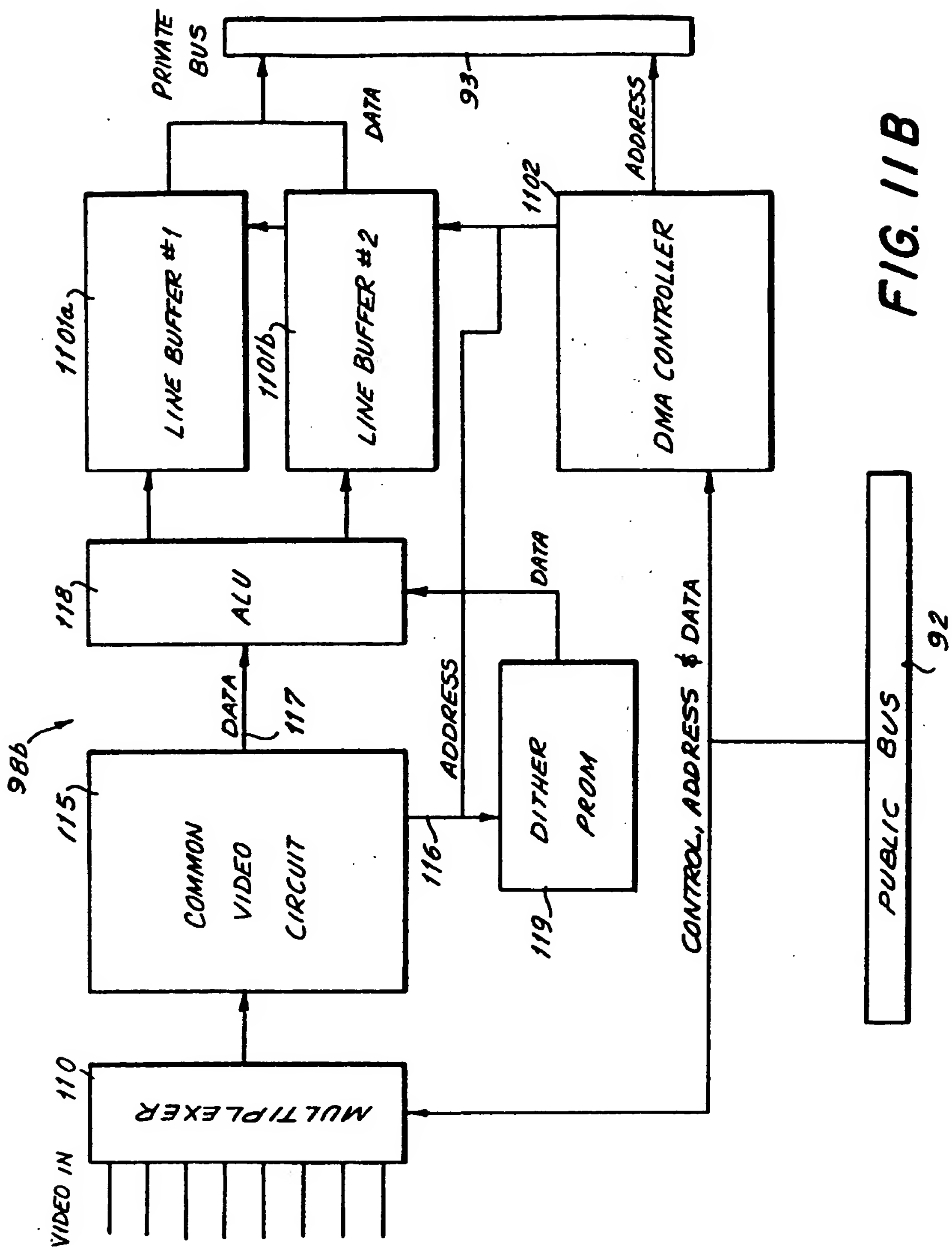

PRIVATE BUS
DATA
93
ADDRESS
1102
1101a
LINE BUFFER #1
1101b
LINE BUFFER #2
DMA CONTROLLER
118
ALU
DATA
98b
DATA
117
ADDRESS
115
COMMON VIDEO CIRCUIT
116
DITHER PROM
119
CONTROL, ADDRESS & DATA
PUBLIC BUS
92
110
MULTIPLEXER
VIDEO IN

FIG. 11B

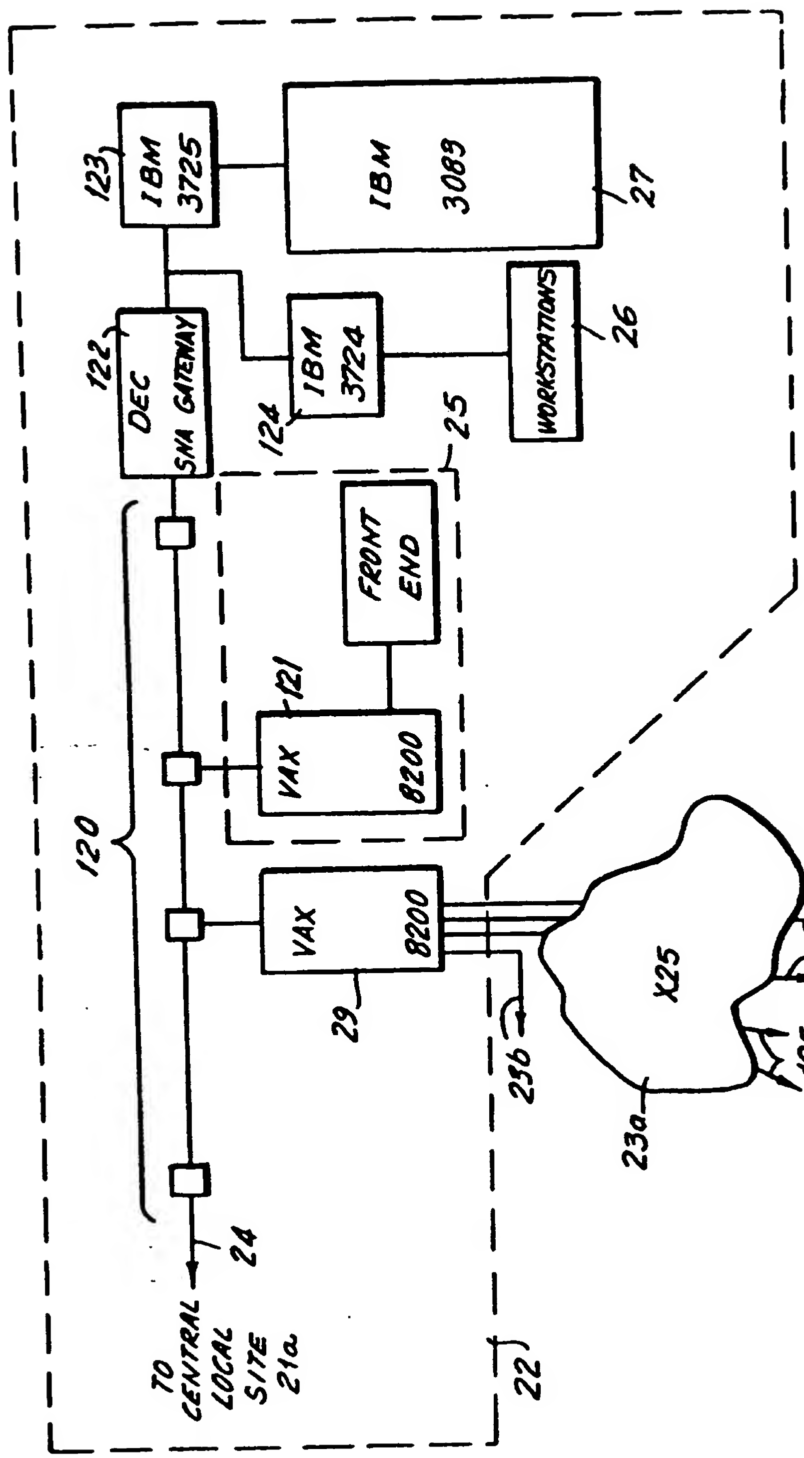

IBM 3725
123
IBM 3089
27
DEC SNA GATEWAY
122
IBM 3724
124
WORKSTATIONS
26
25
FRONT END
VAX 8200
121
120
VAX 8200
29
23b
X25
23a
125
125
125
TO LOCAL SITES 21
24
TO CENTRAL LOCAL SITE 21a
22

FIG. 12